John Squair

THE

ANIMAL KINGDOM:

AN ELEMENTARY TEXT-BOOK IN

ZOOLOGY.

SPECIALLY CLASSIFIED AND ARRANGED FOR THE USE OF SCIENCE CLASSES, SCHOOLS, AND COLLEGES.

BY

ELLIS A. DAVIDSON,

AUTHOR OF "LINEAR DRAWING," "PLANTS, AND THEIR USES IN FOOD, ARTS, AND MANUFACTURES," &c., &c.

Fourth Edition.

WITH ILLUSTRATIONS.

CASSELL, PETTER, AND GALPIN,
LONDON, PARIS, AND NEW YORK.

CONTENTS.

*** *For detailed Index, and Dictionary of Terms, see page* 177.

INTRODUCTION.

THE subject of the Natural History of Animals is in itself so interesting to children, that no persuasion will be required to induce them to read this book, or to attend to such further information or illustration as the teacher may think proper to add to the lessons herein given.

It is therefore to such as have the guidance of the young, that these lines are addressed, in the hope of proving to them that this study is not merely pleasant, but useful—nay, important in the last degree.

It is the sacred office of the true educator to arouse the inquiring faculties of the young mind—to develop every thought and feeling; and can this be better done than by directing the attention to the wondrous wisdom displayed in the works of Nature, and to the infinite mercy by which each animal, however lowly, lives, moves, and fulfils its purpose in the great scheme of the creation? For does not every creature that treads the earth, every bird that flies above us, every fish that wends its way through the waters, every insect that sports so gaily in the air, inspire us with admiration of Almighty wisdom and care? and the thoughts of wonder at the creation, will lead to feelings of gratitude to the Creator—from nature, to nature's God.

But although the endeavour has been made to render as full information as the limits of this work permit, it

can still only be said to afford a cursory glance of, a scanty index to, the Animal Kingdom; the numerous groups of which merge so gradually into each other, that it becomes impossible to establish absolute lines of demarcation between some of the members

The classification given is, however, that which long experience in lecturing on the subject has proved to be the most clear and defined, and therefore the most likely to be comprehended and remembered by the pupils. It is based upon the original system of Cuvier, extended or modified by the investigations of Professor Rymer Jones, Dr. Milne-Edwards, Dr. Shea, Dr. Carpenter, Professor Agassiz, Dr. Carl Arendts, other English and Continental naturalists, and my own personal study.

The uses of animals in the great economy of nature is pointed out, and the edible and commercial products obtained from each is described; the statistics introduced being culled from the most reliable sources.

The importance of the animal creation is thus shown; for whilst from the Mammalia we receive the staple articles of our food, we also obtain from that class bone, leather, hoofs, horns, hides, furs, hair, whalebone, blubber, fat, &c.—nay, the very animal refuse is of the greatest commercial value as manure.

From Birds, too, we receive many and important benefits;* for whilst some perform the office of Nature's scavengers, removing in hot climates quantities of decaying matter, which if left would produce disease, others not only furnish us with the "grey goose quill," by the aid of which the greatest men have conveyed to us their thoughts and discoveries, but also provide us with the material for the soft pillow on which to rest our weary heads. From the flesh and eggs of some, we derive whole-

* See "Cassell's Book of Birds," edited by Professor Rymer Jones.

some and nutritious food, whilst others cheer us with their merry songs; and as the flowers which grow around our feet delight us by their ever varying colours and sweet odours, so do the beauteous denizens of the groves charm us by their lovely music, their brilliant plumage, and graceful movements.

Even from the Reptile class—that which is, perhaps, the least prepossessing—we obtain the valuable Turtle flesh, and the Tortoise-shell. Fishes not only afford us wholesome food in their flesh, but their very intestines are manufactured into edible preparations of great commercial value; whilst sepia, cuttlebone, pearls, mother-of-pearl shells, &c., come to us from Mollusks.

Not only do lobsters, crabs, &c., yield food for thousands, but another group of the Articulata—Insects—are of immense commercial value, producing for us honey, wax, lac-resin, lac-dye, cochineal, silk, &c. To the lowest forms of animal life we owe the formation of a great portion of the crust of the earth, the limestone rocks, &c.; whilst whole coral islands, and immense sub-marine forests of sponges attest the merciful providence of an All-seeing One, who has thus caused the most lowly and most minute creatures to minister to the wants of man.

These constitute but a very few of the products of the Animal Kingdom; yet these will afford the intelligent teacher ample subjects for numerous lessons; and as most of the substances can be readily obtained, the instruction may take the form of object-lessons, which will be deeply interesting to the pupils.

But the knowledge thus obtained will lead to higher thoughts than those engendered by the study of subjects which are merely scientific, or tending to commercial benefit. The science here taught is an investigation of the works of the great Author of all. We are led to contemplate the marvellous construction of animals, and

the wonderful adaptation of the different parts to the work they have to perform. We are shown the merciful organisation by which the most minute, as well as the most gigantic, creature is furnished with means of protection against its enemies, and we learn how every group is provided with feet, stomach, and teeth adapted to the locality in which it is to live, and the food on which it is to subsist.

Now, since every animal is so richly endowed by its Creator with organs and faculties to live, and enjoy its life too, contributing (in ways often inexplicable to us) to the well-being of Man, it follows that **we outrage the Divine plan when we ill-use any of his creatures,** and that we are only allowed to kill them when their life is injurious, or their death necessary to us.

This book, then, is written with the view of promoting the more general introduction of natural history into schools for all classes of society; and this will, I feel convinced, have the ultimate effect of checking, and in many cases wholly preventing, cruelty to animals.

Let a boy who is engaged in an engineer's works, go home and find a model of a beautiful machine. Will he touch or injure it? will he not rather guard and look at it with an admiration amounting almost to veneration? And why is this? Because he will have learned how such machines are constructed; he will have observed the infinite care and delicate workmanship required in fitting them up, and hence his appreciation.

Even so will it be with *living machinery;* for the boy who has received at school an interesting lesson in natural history, who has had the wonders of the Animal Creation explained to him, and who has been taught to see the mercy and goodness of God in the Insect as in the Elephant, will not in his way home strike or kick the poor Ass he meets. Nor will the child who has been shown

how wonderfully the harmless crawling creatures percolate the ground so that the rain can sink into it, wilfully tread upon the worm by the road-side ; he will "turn his hasty foot aside," and will scorn to take away the life he cannot give. And the child who has been shown in a microscope the exquisite structure of insects, will not be likely to stick pins through live butterflies, or pull out the legs of flies.

The boy is the father of the man ; and the habits of consideration thus early grafted will grow and strengthen, and will in after life curb the hand raised in cruelty to animals, and in violence to fellow creatures.

But the girl is the future mother of the coming generation, and on her knee will the child learn those first lessons which will leave an indelible impression on its mind, and therefore the education of our girls in natural history is as important as that of boys—perhaps more so for from the female we are accustomed to expect mercy and refinement, and mothers, sisters, and wives can exercise over the rougher sex softening influences, the extent of which it is impossible to over-rate.

What beautiful lessons can the mother draw from the book of Nature, so bountifully opened for her, and how her children will love her for it! how she will thus be able to lead them to the Source from which all blessings flow—and how they will, in years when the world has ploughed deep furrows on their cheeks, remember these lessons, and love them the more because their mother taught them !

We see that all Nature lays her productions at the foot of man ; that the cow which browses in the valley, and the goat that feeds on the mountain-top—the bird which flies in the air, and the fish which inhabits the waters—assimilate the nourishment they receive from what they eat, until it becomes part and parcel of their flesh, and so

contributes to the food of man; whilst others, by their willing labour, have become our friends and servants in every climate. We shall have then obtained more than mere earthly wisdom, but shall feel the truth of the verses:—

"Thou madest him to have dominion over the works of thy hands; thou hast put all things under his feet:

"All sheep and oxen, yea, and the beasts of the field;

"The fowl of the air, and the fish of the sea, and whatsoever passeth through the paths of the seas."

"O Lord our Lord, how excellent is thy name in all the earth!"

ELLIS A. DAVIDSON.

THE ANIMAL KINGDOM.

WHATEVER work we engage in, or whatever study we enter upon, we shall find our task lightened if we arrange our course according to a regular plan. This **order** pervades the whole of Nature, and every single thing, be it an animal, a plant, or a stone, has its precise place, each having some particular feature, habit, or power, by which it differs from others. These differences are in some cases very small, in others very great, and it has been by carefully examining the exact formation and mode of life of each animal, that naturalists—(one of the greatest of whom was Baron Cuvier*)—have been able to divide the animal kingdom into **Classes, Orders, Genera,** and **Species.**

Now let me explain to you the uses, nay, the absolute necessity of classification. You know that in Australia there are some people who have emigrated from almost every country in the world, and there is no doubt that many of them require to send letters or parcels to their

* Baron Cuvier was born at Mömpelgard (a town formerly belonging to Würtemburg, but now to France), on August 23rd, 1769. His father was an officer in a Swiss regiment, and the restricted means of his family compelled him to take a situation as tutor. He had, however, displayed great fondness for natural history when only twelve years old, and during the six years he spent as a private tutor, he zealously pursued his favourite study, and so successfully, that on coming to Paris, he was, in 1795, appointed Professor to the Ecole Centrale in the Pantheon. He laid the foundation of the now universally admitted classification in zoology. Cuvier died May 13th, 1832.

relatives, friends, or business connections, in their native country. One wishes to send a letter to his mother in Germany, another desires a parcel to be sent to France, and a third is writing to England; some are sending goods to the Cape of Good Hope, others to New York, and others are sending letters to China.

The first thing to be done is, to sort out these parcels and letters, then it will be seen that those for Germany, France, and England, have more connection with each other, than those for the Cape of Good Hope, New York, and China have, because they can all be grouped together as belonging to Europe, whilst the others belong to Africa, America, and Asia. So that we have classified the parcels according to the primary divisions of the world to which they belong. But this is not enough, for Germany, France, and England are only *portions* of Europe, and, therefore, the letters and parcels must be again sorted, so that they may reach the exact town and street, nay, the very house to which they are directed.

How this is all done will be best seen by following up the Englishman's letter. Let us suppose that he is ordering some volumes of the "Popular Educator;" he therefore addresses his letter to "Messrs. Cassell, Petter, and Galpin, La Belle Sauvage Yard, Ludgate Hill, London, E.C." Now all these separate names are so many pieces of information, which assist in finding the exact spot to which the letter is directed. Thus the letter is found to belong firstly to Europe, then to England, then to London. Now, as London is very large, it is divided or classified into what are called postal districts, as E. (East), W. (West), &c. &c., and this letter is marked E.C., so it is sorted amongst those belonging to the Eastern Central division; and the sorters, who again divide all these according to their streets, place it in the hands of the letter-carrier, to whose district it belongs, and he again classifies his letters according to

street, number, and name, and so, by means of classification, all the letters reach their destination. But all the trades of each large town are classified, so that if the letter had only been addressed, "Messrs. Cassell and Co., Booksellers, London," we could look in that part of a large book called a Directory, amongst the names of the booksellers, and there we should find the address.

In this way all knowledge is classified, and therefore it is important that before we read about individual animals, we should learn how they are divided into groups; and by this means we shall find our studies very much simplified.

By the term **Species** is meant a number of animals precisely alike; as the mouse *species*, in which it is scarcely possible to distinguish one individual from the other. One may be old and another young; one great and stout, and another little and thin; but this would be no real difference.

There may, however, be slight differences caused by climate, or other circumstances which merely alter colour or cause some trifling difference, without altering the nature of the animal. Thus, there may be grey mice, piebald mice, and white mice; and these are called **varieties** of the species.

A **Genus** is a group embracing several species, all of which resemble each other in the most important particulars, but which have certain minor differences, by which they may be distinguished; thus, the mouse is at once seen to differ from the beaver or the hare by its long and tapering tail, although it has teeth of the same character. But there are other animals which have the same sort of tail, and are much like the domestic mouse in several particulars; and these are therefore said to belong to the same **genus.**

An **Order** is a much greater group, and includes several genera. Thus, the tail may be different in every genus,

but it is not of sufficient consequence to make any real distinction in their mode of life. A rat may have a long tail, a beaver a broad, flat, scaly tail, a squirrel may have a bushy tail, very much like a banister-brush, a porcupine may have a stumpy tail, and a guinea-pig no tail at all; but all these animals are alike in the leading particular, namely, that *they have all sharp chisel-like front teeth*, which enables them to cut and gnaw; so they are all grouped under the order Rodentia or gnawers.

But still further grouping can be accomplished, and we gather several orders together into a **Class**: thus, some animals have pouches in which they carry their young; others are very large and live in water, but come to the surface to breathe; some have very thick skins; others chew their food over and over again; some have not any teeth, whilst others can gnaw through the hardest wood; some live on flesh; some have their hands turned into flying machines like wings, whilst others have thumbs on their feet, making them nearly like hands; and others (man) have two hands, and can think and speak. Yet, different as all these are, they agree in one great particular, namely, that the *young ones which are born alive, suck milk* from the *mammæ* or teats of their mother, and the whole class is therefore called **Mammalia.**

I shall endeavour to work out this classification for you as clearly as possible; but you will already have seen that zoology is of great importance to you, not only because it teaches us the forms and habits of numerous animals, but because it accustoms the mind to habits of order, precision, and inquiry—requiring us to compare one animal with another, and to observe the different features and habits of each. However, I must urge you not to be content with what you learn from books, but to study and examine for yourselves; for every animal you meet with has some peculiarities which will afford food for

observation, and in watching these and comparing them with those exhibited by others, and in observing how marvellously the organs of every animal are adapted to its mode of life, you will be led to think of the wisdom of God and of his mercy to even the smallest of his creatures.

Cuvier classified the whole of the animal creation into four grand divisions, and as this classification has been generally adopted, it will be followed in this book—excepting as regards the fourth division, which, owing to the increased knowledge of recent naturalists, has been further divided, as will be seen hereafter.

The following is the

Classification of Animals according to Cuvier.

- **Vertebrated or Back-boned Animals** — such as: Man. The Horse. The Mouse.
- **Invertebrate (without back-bones).**
  - **Articulated or Jointed Animals** — such as: The Crab. The Spider. The Fly.
  - **Mollusks or Soft-bodied Animals** — such as: The Oyster. The Snail. The Cuttle.
  - **Radiated or Star-like Animals (Including Protozoa or First Animals)** — such as: The Sea Star. The SeaAnemone. The Sea Urchin. &c. &c. &c.

In order to remember the principal features of any particular class of animals, it is best to fix upon one as a model which possesses all the characteristics of the whole group. This one is then called the "Type."

The following four pictures will be of great use to you, for you will of course see that the horse has a back-bone (vertebra), and this will remind you that all animals having back-bones are called **Vertebrated;** and when you look at the Crab (Fig. 2), you will remember that it is covered with a hard crust which, indeed, represents its skeleton

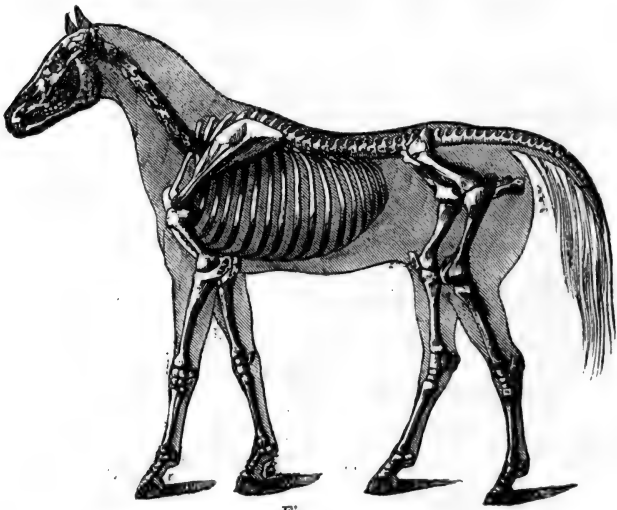


Fig. 1.

Example of Vertebrated or Back-boned Animals.

THE HORSE.

growing *outside*, instead of inside, as in Vertebrata. The different portions of this external skeleton are jointed into each other, and, therefore, the whole of this division is called **Articulated,** which is derived from a Latin word meaning jointed.

This external skeleton is not always the hard casing in which the Lobster or Crab is contained: it is sometimes

only like a thickened skin, as seen in the Spider and in insects; and if, by the aid of your microscope, you examine the leg of the smallest insect, you will find it

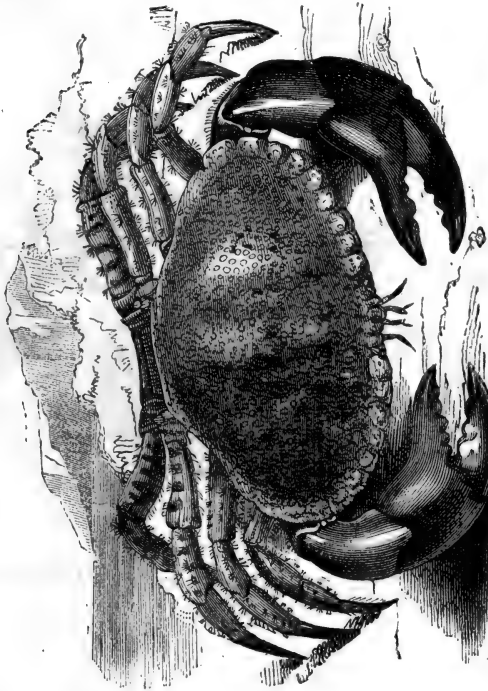


Fig. 2.—Example of Articulated or Jointed Animals.
THE CRAB.

jointed together in precisely the same manner as that of the crab.

Again, when you look at the sketch of the Snail (Fig. 3), you will at once be reminded that all these animals are soft-bodied, and that therefore, though different in form, they are all classed under the name of **Mollusks**. You must

not, however, think that the shell of a snail or mussel is in any way like the case in which the articulated animals live. You have been told that in the crab and similar animals this covering is the external skeleton, but in the Mollusks it has no connection with the body of the animal

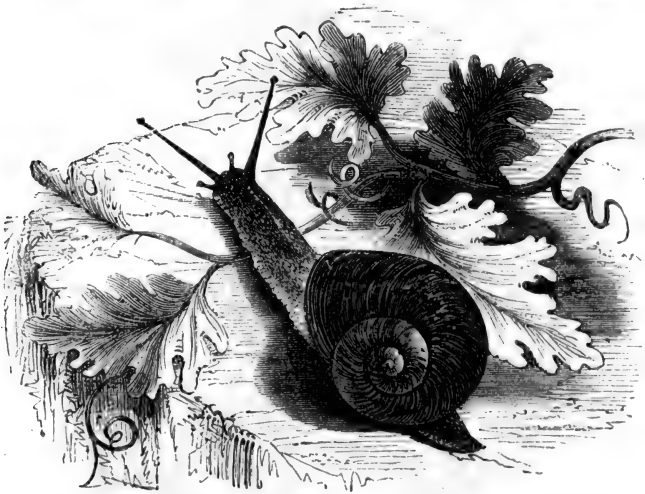


Fig. 3.

Example of Mollusks or Soft-bodied Animals.

THE SNAIL.

—it is merely a house, which it carries on its back, and into which it can withdraw itself.

Further, you know the snail which you see in the garden has a shell; whilst the slug, which is nearly the same in every respect, has not; and there are others which have a mere remnant of a shell, which seems just left to remind them that some of their relations have comfortable houses to dwell in; and thus you will see that the hard casing is not *always* possessed by the Mollusks.

The drawing of the Sea-star (Fig. 4) will serve to remind you that the animals from which this division is named, radiate, or spread out from the centre in a star-like form, and they are, therefore, called **Radiata;** but, as you have

Fig. 4.

Example of Radiated or Star-like Animals.

THE SEA-STAR.

been told, this is but a very imperfect name; for since the days of Cuvier, so many forms have been discovered, and so many observations have been made, owing to the great improvements in our microscopes, that the whole of this division has been re-arranged, and will be described in its proper place.

It is necessary to remind you that in order to render the pictures of the different animals as plain to you as possible, they have each been drawn as large as circumstances allow ; but, in consequence of this, it is impossible to draw them so that they may represent the relative size of one to the other. But your own sense and observation will guide you in this respect, and in most cases the size of the animal will be mentioned in the text.

VERTEBRATE ANIMALS

ARE DIVIDED INTO

	Leading Characteristics.
Mammalia.	The young are born alive, and suck milk. They breathe by means of lungs, and have hot blood.
Birds . . .	The young are produced from eggs. The front limbs take the form of wings. They breathe by means of lungs, and have hot blood. The body covered with feathers.
Reptiles. .	The young produced from eggs. Some have four limbs, others have not any. They breathe by lungs or gills, and have cold blood. The body for the most part covered with scales.
Amphibia .	They are furnished with the lungs of land animals and the gills of fishes, so that they can live on land or in water.
Fishes . .	The young are produced from eggs. They are entirely without limbs. They breathe by means of gills. The body is covered with scales or bony plates.

MAMMALIA.

THE first characteristic of the great class called Mammalia is that from which their name is derived,* viz., that they suckle their young, which are born alive.

They all breathe air by means of lungs, and have hearts with four compartments—two auricles, and two ventricles. The most perfect form of lungs and heart have been shown in the description of those possessed by human beings†—for man stands at the head of all created things, and animals are termed "higher" or "lower," according as they approach him in organisation.

When we speak of the lower animals, however, we do not mean that any one of them is imperfect in its structure, for all are equally fitted for the position in which they are placed, and every created thing, however small or apparently insignificant, bears evidence of the wisdom and design of the merciful Creator of all. Throughout creation we find the most wonderful harmony existing between all the organs of animals and their habits and instincts, so that none of them could exchange any portion of its structure with another and be equally fitted for its sphere of action.

So perfect is this organisation, that from a single tooth the student of science can discover the class of the animal to which it belonged, and can speak with certainty of its structure and general habits.

The teeth, indeed, are organs of great importance in Mammalia, being specially adapted to the food on which the animal is to live, and to its habits of life. Thus man, who is said to be omnivorous (or *everything eating*), has some teeth of each of the kinds possessed by the other

* *Mamma*, the breast.

† "Our Bodies," Cassell's Primary Series. Pages 61 and 68.

Mammalia.* The flesh-eating animals have front teeth, which they can strike into their prey like so many sharp hooks, whilst their back teeth work against each other like the blades of strong shears, and so cut up their food. Those animals which live on grass and herbage have sharp, flat, front teeth, which work against a pad in the upper lip, and cut off the grass close to the ground, something like a carpenter's adze † takes off chips; and the back teeth, which are broad and flat, are made to move horizontally over each other by a lateral (or sideway) motion of the jaw, which you have no doubt noticed in cows and horses. In squirrels, beavers, &c., the front teeth are like chisels, and not only continue growing, but, by a peculiar formation, they keep constantly sharp, however much the little carpenter may use his tools, and however hard the wood may be in which he has to work. Thus, the squirrel can cut through the shells of nuts, the beaver can chop down branches of trees, whilst their back teeth rub over each other just like a pair of rasps or rough files.

The feet of Mammalia, too, are adapted to their various modes of life. Thus, the camel has broad, spongy soles, which enable it with comfort to tread the sandy desert, and has pads on its limbs, on which it rests when it kneels; the lion has strong, terrible claws, by which he can catch his prey; the monkey has all his feet formed like hands, by which he is enabled to grasp the branches of trees in climbing; whilst in the horse and other animals adapted for walking on firm soil or bearing burdens, the feet are enclosed in hoofs, which form natural shoes.

The feet and teeth, then, are points upon which classification is mainly based, since these are always found to be adapted to the special requirements of the animal.

* *See* "Our Bodies," page 44.

† "Our Houses," Cassell's Primary Series, Fig. 32.

MONOTREMATA.

THE Monotremata form an order which seems to connect the true Mammalia with animals whose young are produced from eggs. This group is almost entirely limited, in geographical position, to Australia; and at present only two genera of this singular class is known: namely, the **Echidna** (Fig. 5) or Porcupine Ant-eater, and the **Ornithorhyncus** or **Duck-billed Platypus.**

The **Echidna** is a little animal which is spread over the sandy portions of Australia, but is seldom found in the more northern parts. It feeds on ants and other insects, for which it burrows with its strong claws and beak-like nose; and it gathers its prey into its mouth by means of a very long tongue, somewhat like the Ant-eater, of which a description is given on page 64. The body is covered with stiff spines, like our Hedge-hog; in fact, the Australians generally call it by that name; and it has the same habit which our little blackbeetle-eating friend has of rolling itself up when alarmed. But it has other means of protecting itself, for on soft soil it can dig with such rapidity that it seems to sink into the ground as if by magic.

The Ornithorhyncus* or Duck-billed Platypus† (Fig. 6), is such a strange creature, that it is said, when the first one arrived in Europe, naturalists suspected that the bill of a bird had been affixed to the head of the four-footed animal by some artificial means; but, however curious it may appear, the union is a natural one; in fact, the whole structure of the animal is such that it has been named "*Ornithorhyncus paradoxus.*" It is called by the natives of Australia the *water mole*, as it lives on the

* From *Ornis, Ornithos*, a bird; and *rhynchos*, a beak (Greek).
† From *Platus*, flat; and *pous*, a foot (Greek).

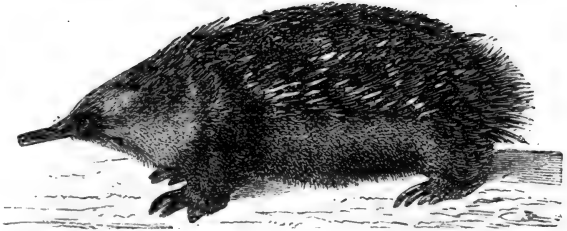


Fig. 5.
THE ECHIDNA,
OR
PORCUPINE ANT-EATER.

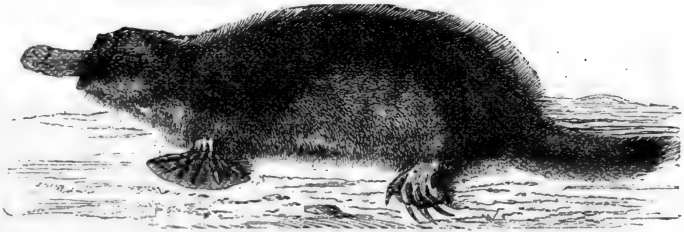


Fig. 6.
THE ORNITHORHYNCUS,
OR
DUCK-BILLED PLATYPUS.

Monotremata.

banks of streams, in which it burrows. It tunnels passages sometimes fifty feet long, at the end of which it forms a nest of grass and weeds, and in this the little creatures with the very long names are reared. It shovels up its food with its flat bill, like a duck does, and is an excellent swimmer, its feet being furnished with membranes between the toes, like those of the duck, but the web folds back when burrowing, leaving the claws free; so you see, that however strange the animal may seem to us, it is well supplied with means by which it is enabled to provide for its own comfort and that of its young.

MARSUPIALS.*

THE animals which form the leading members of this order, are found in Australia and America, and receive their name from a pouch or bag in front of the body of the female.

You must know, that although the young of the Kangaroo, which is the type of Marsupials, are born alive, that is quite as much as can be said of them, for they are so extremely helpless that they cannot even suck. Immediately after their birth, therefore, they are placed in the mother's pouch, and each attaches itself to a teat, out of which the milk is pressed into its mouth. And strange-looking little fellows they are, only very little more than one inch long, covered by a flesh-coloured, semi-transparent skin. Their tail at this period is extremely short, and their fore paws are one-third longer than their hind paws. They remain in the pouch for about eight months, popping their heads out occasionally, as if to see what sort of a place the world is, or to taste the high grass; and should any one tumble out, the mother

* *Marsupium*, a pouch.

Fig. 7.—Marsupials.—The Kangaroo.

picks it up with her fore paw and puts it back again. By this time they have generally reached ten pounds weight; they then make their public appearance on the grass, and begin to shift for themselves; but at first they return on the slightest signs of danger. In fact, even when they are quite old enough to know better, they push their heads in to take a little refreshment, even though a little brother or sister may be in the cradle.

As the young Kangaroo grows up, very important changes take place in its form. The hind legs become immensely longer than those in the front, and the tail becomes very long and thick. The animal scarcely uses its front paws, excepting to lean upon when stooping forward to feed off the grass. Its usual position is upright, sitting upon its hind legs and tail, and it moves by long leaps, the tail acting like a strong spring which pushes it forward. There are four toes on the foot of the kangaroo, the middle one of which is very large and powerful, and is furnished with a strong hoof-like nail, which makes the foot a very important weapon, with which it frequently kills some of the dogs which are employed in hunting it.

Opossums.

The Opossums form another group of the Marsupials, but in some of these the pouch is entirely wanting—its place being merely occupied by a fold in the skin. One of the largest of the family is the Virginian Opossum, which is about the size of a cat. This was the first of the Marsupials which became known, and you will believe that she must be a good specimen of animals with pouches when you are told that the young family to be accommodated in that nursery sometimes amount to *sixteen* in number. Certainly they are not very large when first born, for it is only when they have been there fifty days

that they reach the size of a mouse. Their eyes are then opened and they are covered with hair. They leave the pouch at this period, but, like their relations the little kangaroos, they are glad to scamper back again to its friendly protection the instant any danger appears.

Some of the Opossums which are without a pouch are in the habit of taking their families out for an airing in a still more strange manner. They place the little ones on their back and run about over the branches of trees in that way. But, you will ask, is not this very dangerous? Might not the baby opossums fall off? Well, you must know that they have very long tails, and during their journey the young ones twist their tails round that of their mother, so that, even if they were to slip off her back, they would hang on to the tail. The annexed drawing (Fig 8) represents one of the family, generally known as Merian's opossum, from its having been described by Madame Merian in the year 1719.

Another of this family is the Flying Opossum (Fig. 9), so called because the skin on their sides is spread out like a sail between their hind and fore legs, which enables them to sustain themselves in the air during wonderfully long leaps. The one here drawn is a very pretty little creature, about the size of a small rat, and is called the "pygmy petaurus," but some of the family are much larger—the squirrel petaurus being sixteen to eighteen inches long. It goes by this name in Australia, to which it belongs, because in several other parts of the world a family of squirrels are furnished with this flying membrane, and are hence called flying squirrels. You would soon, however, be able to tell whether an animal which might be shown you belonged to the opossum or squirrel family, for the opossums have by far more teeth, and these are not formed like chisels for cutting wood, but for crushing, &c.; their food consisting of insects, birds, small reptiles, and

Fig. 9.—FLYING OPOSSUM.

OPOSSUMS.

Fig. 8.—MERIAN'S OPOSSUM.

even fruits, and one family of them feeds on crabs, which it catches in the marshy places in which it likes to live.

CETACEA.

THE Cetacea may next claim our attention, for we can separate them from all the rest of the Mammalia by their fish-like form, and by their possessing only one pair of limbs, which are converted into swimming paddles. The tail, instead of being parallel to the sides of the body as in fishes, is placed at right angles to it—that is, parallel to the surface of the water. This arrangement is of great service to the animals, for they not only use this tail fin for ordinary progression (in which case they move it slantingly downwards and sideways as we work our paddle in sculling a boat), but it assists them materially in rising to the surface of the water, which they are compelled to do in order to breathe. When you are told that the breadth of the tail fin in some of the larger species is 20 feet, and its surface not less than 100 square feet, you will not be surprised to hear that by one blow of it, whaling-boats have been thrown into the air and the bottoms of ships injured; in fact, such is its power, that by striking it against the water, whales 80 feet long have been seen to leap clear above the surface, as dace and other little fish do when rising after flies.

The manner in which the oily matter called blubber is placed in whales requires some explanation. In other animals, fat is placed as a layer beneath the skin and in various depressions on the surface of the flesh, so that when the skin is drawn off, the fat still remains. You will have noticed this in the sheep, &c., which are hung up in our markets; but in whales the blubber is in the *substance of the skin* itself. This arrangement is of great service to the animals, firstly, because it keeps them warm by prevent-

ing the heat of the body being carried off by the water; secondly, by its elasticity it enables them to bear the pressure of the water when they dive into the depths of the ocean, a pressure sometimes amounting to ten tons on every square inch of the enormous surface; and thirdly, the blubber being so much lighter than water, it assists the huge creature in rising to the surface by buoying it up: this is proved by the circumstance that a dead whale floats, but when deprived of its blubber the carcase sinks.

Cetacea may be divided into Carnivorous, or flesh-eating, and Herbivorous, or feeding on vegetable matter.

The Carnivorous Cetacea consist of Dolphins, Spermaceti, and Whalebone Whales.

Dolphins have slender sharp teeth in both lower and upper jaws, and are very voracious; they may be easily distinguished by the peculiar shape of their head, which terminates in a beak-like snout. They are abundant about our shores, and no doubt many of you have seen the shoals of them tossing about in their elegant sports.

Porpoises differ from dolphins, chiefly from being smaller, and having no prolonged snout, their muzzles being comparatively short. Both of these animals follow sailing vessels in herds, and pick up any sort of offal which may be thrown overboard, and perform the most amusing gambols. Their name is supposed to be derived from the French term "Porc-poisson," or Hog-fish, for you must know that formerly all the Cetacea were thought to be fishes, and it was common to hear people speak of the "*Whale-fish*;" in fact, now that we know that the Whale is a Mammal and not a fish, it seems absurd that we still speak of our "whale fisheries."

To the Dolphin tribe belongs the **Narwhal,** or Sea Unicorn. The name Unicorn means "single horn;" but the fact is, that the spear with which the male Narwhal is

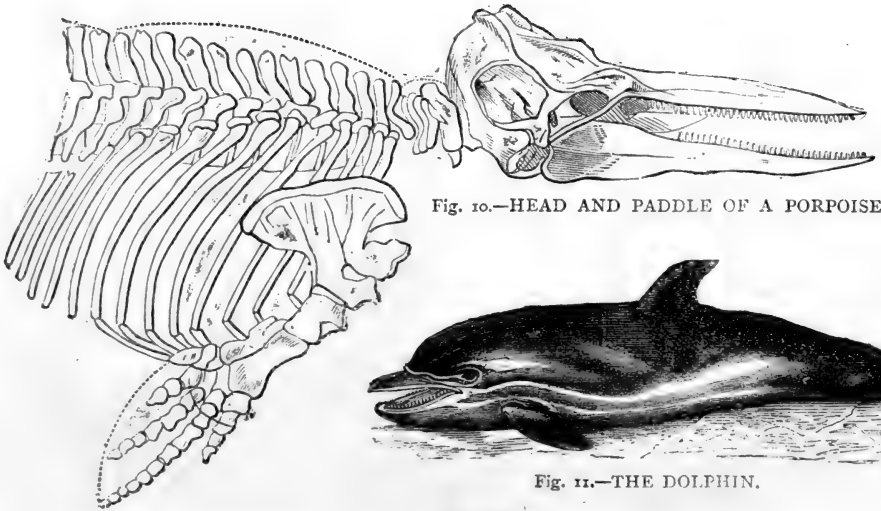


Fig. 10.—HEAD AND PADDLE OF A PORPOISE.

Fig. 11.—THE DOLPHIN.

Cetacea.

armed, is not a horn, but a *tusk*—it is, in reality, one of its two front teeth which has grown out to the amazing length of eight or ten feet, whilst the second tooth has not been developed at all. The tusk is composed of ivory, and has a spiral twist. The Spermaceti Whale is remarkable for the size of its head, the length of which equals the rest of the body, whilst in bulk it exceeds it. It is not, however, the skull which gives such size, but an immense mass of waxy matter, called *Spermaceti* and oil, which is contained in a large bag placed in a hollow on the front of the head. The Spermaceti is separated from the oil in which it is originally dissolved by boiling water, from which the spermaceti crystallises as it cools. Spermaceti is called *demulcent* and *emollient;* both of these terms mean having the property of smoothing and softening the textures to which they are applied, but the first

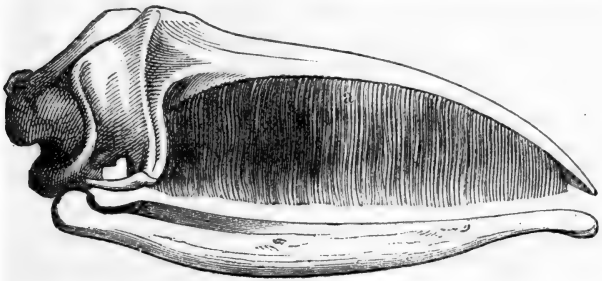


Fig. 12.

implies inward and the second outward application: thus, as a demulcent, spermaceti is used as an ingredient in cough mixtures, whilst for an emollient it is mixed with white wax and almond oil, and is thus made into the spermaceti ointment, the healing property of which is so well known. From the Spermaceti Whale another substance

called *Ambergris* is obtained; it is valued as a perfume, and is sometimes found floating in large lumps on the seas near the South Pole, which these creatures most frequent. The spermaceti whale is also provided with a layer of blubber, which yields less oil than that of the common whale, but its quality is thinner and purer.

The Greenland, or Whalebone Whale is the best known to us. This species has not any teeth, and the mouth is furnished with a heavy fringe called *whalebone*, which acts as a strainer. As the whale swims along with its immense mouth open and this sieve hanging down, the water passes in between the fibres, carrying with it quantities of very small marine animals, but keeping out all larger ones, the swallow not being large enough to admit even small fish. Now you must know that the nostrils of the Whale are placed at the top of his head, so that he is able to breathe the moment he reaches the surface of the water; and for this purpose he rises generally every eight or ten minutes, though he can remain under the water for more than half an hour, and when he thus breathes through his nostrils he blows out a quantity of water which had entered at the mouth; this process is called *spouting*. The blubber of whales has already been mentioned. In this species it is from one to two feet thick, and is not only of value to us, but to the natives of the polar regions it is more important still, as, indeed, are almost all the parts of the huge body. They eat the flesh and drink its oil; and, unsavoury as such food may appear to us, we must remember that in those climates there are but few other animals which can be eaten, and that this fat is of that species of food called "heat-givers," and hence, is absolutely needful in keeping up the proper warmth of the body. The annexed engraving (Fig. 12) will show you how the whalebone is placed in the skull of the animal, and you will also notice the utter absence of teeth.

HERBIVOROUS CETACEA.

THE Herbivorous Cetacea consist of Manatees and Dugongs.

The **Manatee,** which is found principally on the shores washed by the Atlantic Ocean, is covered with a very tough hide; the flesh underneath is said to be very good eating, and when dried and salted remains sweet for a year. The muzzle of the Manatee is round, and the nostrils are placed in the front, not at the top of the head as in whales; the tail, too, is thick and fleshy, whilst in the Dugong it is forked; the skull of the Dugong differs also from that of the Manatee, the upper jaw being bent downwards and terminated by two tusk-like teeth, which enable the animal to tear up and gather the marine vegetation on which it feeds.

These animals have the curious habit of swimming and gambolling with their heads and necks out of the water, and their tails turned up into the air; when the female is nursing, she carries her child under her one arm, keeping her head and that of the little one above water whilst she paddles with her other limb. They seem most affectionate creatures, and if one of a pair be captured, the other is easily taken, as it would suffer itself to be killed, rather than leave the dead body of its late partner. These strange habits have no doubt formed the foundation for the fables of ancient times, of sirens, mermaids, &c. The name of the Manatee is derived from *manus*, a hand, because the animal is furnished with limbs which can be moved round like our hands; the Dugong is called "Halicore," meaning the Sea-Maiden.

Having thus separated such of the Mammalia as exist under conditions different from all the rest—namely (1) those whose young, although born alive, are but imperfectly

developed at their birth, and (2) those who, being fish-like in form and habits, are still mammalian in all other considerations—we can now divide all others into two great groups, viz. :—

Ungulated, or such as have their fingers or toes more or less consolidated and enclosed in hoofs.

Unguiculated, or such as have separate fingers and toes, terminated by distinct nails or claws.

The Ungulated at once fall into two groups, viz. :—

1. **Pachydermata,*** or thick-skinned, as the Elephant, Hog, &c.
2. **Ruminants,** or cud-chewing animals, as the Ox, Sheep, &c.

The Ungulated Pachydermata may be divided into six families, which are represented by—

1. The Elephant, which has five toes enclosed in a sort of hoof, so that only their ends are visible.
2. The Hippopotamus.
3. The Hog.
4. The Tapir.
5. The Rhinoceros, and
6. The Horse.

It is almost needless to remind you that the **Elephant** is the largest land animal *now* living. There were formerly two species in existence, which were much larger. The one was called the Mammoth, of which great quantities of bones and tusks are found in Siberia. At the beginning of the present century a complete carcase of one of these animals was found imbedded in the ice at the mouth of

* *Pachys*, thick; *derma*, the skin.

the river Lena, which was in such good preservation that dogs and bears fed off it.

This animal was covered with a mixture of bristles and short close hair, and seems thus to have been adapted for a colder climate than that now inhabited by Elephants; still it is supposed that at the period of its existence Siberia cannot have been as cold as it now is, for there would not have been sufficient vegetation for the sustenance of such immense herbivorous animals.

The second of these gigantic extinct Elephants was the Mastodon, so called from the peculiarities in its teeth. The remains of the largest of these have been found in North America; but some belonging to other species seem to have been natives of the old world, and even of Britain.

You will be interested to read the following extract from Dr. Carpenter's excellent work on Zoology, in relation to the animals which formerly existed in our country, but which are now confined to warmer regions.

"There is abundant evidence, derived from fossil remains which occur in the newer tertiary strata (those which lie above the chalk), in gravel-pits, and in caves, that the larger Feline and Hyænine animals were formerly distributed much more extensively; that lions and tigers of greater bulk than any at present existing, roamed over the plains, and inhabited the jungles of Europe, and even of our own country; and that gigantic Hyænas and enormous Bears dwelt in the caves which occur so frequently in our limestone rocks; dragging thither the carcases of the animals they had slaughtered, and prowling about at night, with glaring eyes and savage howls, in search of prey. In many of these caves are now found vast heaps of bones of the animals thus destroyed, which must have accumulated during many years, together with the bones of the rapacious beasts which had their dwelling there. And it is a remarkable proof that these caves

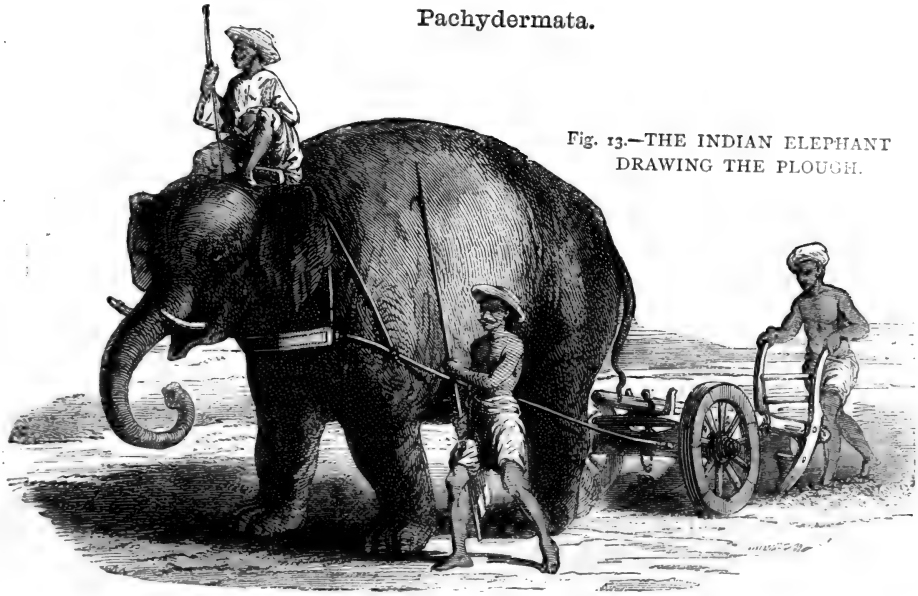


Fig. 13.—THE INDIAN ELEPHANT DRAWING THE PLOUGH.

really were the dens of Hyænas, and that the collections of bones found in them were not merely washed into their entrances by some great convulsion which swept these races from this part of our globe ; that many of the bones of the Oxen, Antelopes, Deer, &c., which accompany them, bear the distinct marks of the Hyæna's teeth. The existence of these gigantic carnivora* in what are now the temperate regions of the globe, seems clearly to indicate that the climate of these parts must have been formerly much warmer than at present—a conclusion which is confirmed by many other circumstances. It is further interesting to remark that, as at the present time we only find the larger Carnivora existing in countries inhabited by large species of herbivorous quadrupeds, on which they may prey, so in former epochs we never found the one set of races present without the other : the herbivorous to supply the carnivorous with food ; the Carnivora to restrain the otherwise excessive multiplication of the Herbivora, and to remove their decomposing remains from the surface of the earth."

Fig. 14.
LAST LOWER TOOTH OF AFRICAN ELEPHANT.

The Elephant, although gigantic in size, is mild and docile, and rarely uses its power of injury unless greatly irritated. They are very intelligent, and seem to remember kindness as well as cruelty. Their teeth are adapted entirely to vegetable food ; the enamel, or hard portion, instead of covering the whole surface, is arranged in vertical plates, with the softer portions of the substance of the tooth

* In a fissure recently laid open on Durdham Down, Bristol, were found, besides other remains, teeth of hyænas as much surpassing those of the largest tiger now existing, as these last exceed those of the largest hyæna.

between them. Thus, as the tooth is used in grinding down the food, the softer parts wear away, leaving ridges of enamel standing. These grinders, too, are changed several times ; for, as each molar is worn, it gives way to another, which is pushed into its place.

The well-known tusks of the Elephant are two teeth, which project downward and forward from the upper jaw, and grow from a pulp which is continually forming new ivory.

The weight of a pair of tusks is from four to five hundredweight, and to support this a short neck is necessary, which is compensated for by the trunk. This is merely the nose or snout elongated, and is made up of some forty thousand small muscles, interlaced on all sides, which give it such an amount of flexibility that it can be turned about in every direction. It consists of a double tube, and at its end it has a curious appendage something like a short finger. By the aid of this it can pick up a pin, untie knots, and has even been taught to hold a pen. The Elephant feeds and drinks by means of its trunk, for of course it would be impossible, with such projections as its tusks, to get its mouth near any food. Dr. Lankester tells us that 50,000 elephant tusks, weighing 10,000 hundredweight, are imported every year.

Only two specimens of Elephants are now known to exist.

(1) The **Indian,** which has a long head, ears of middling size, very short tusks, and has four nails on the hind feet.

(2) The **African,** which has a rounder head, very large ears, and but three nails on the hind feet. It is much more fierce than the Indian elephant, and its tusks are much longer.

The ridges of enamel are nearly parallel to each other

in the molar teeth of the Indian, but are diamond-shaped in those of the African elephant (Fig. 14).

Elephants generally associate in companies consisting of from fifty to a hundred, led by an old one, and it is said that the next in age watches in the rear. They are easily tamed when young, and are used in their native countries as beasts of burden, and have been frequently employed in both ancient and modern warfare. They can carry about two thousand pounds weight, will travel forty miles a day or more, and can swim well. They live to the age of nearly two hundred years.

The **Hippopotamus,*** or River Horse, has its home in the rivers of Africa, principally south of the Equator. Their feet are so constructed that they can either walk about on the marshy ground on the banks, or amongst the mud and reeds at the bottom of the water, or swim with rapidity. They prefer waters, the currents of which are not very rapid, and they are therefore fond of the inland lakes. Their hoof is divided into four toes, which spread out, and so afford a broad basis for the animal to rest upon.

The Hippopotamus was formerly a resident of Europe; in fact, fossil remains of it are found in the London clay, showing that it lived in our rivers. It is, when left to itself, peaceful in habits, but it cannot always be left to itself, for it pays nightly visits to the cultivated lands and commits sad depredations, not only demolishing immense quantities of the growing crops, but treading much of it down and producing sad havoc. The cultivators, therefore, dig pits, each having a long spike in the centre, which, if the animal falls into the trap, pierces his huge body. Another sort of trap is called the "downfall," which is a log of timber heavily weighted at one end, and

* This name is derived from *hippo*, a horse, and *potamos*, a river (Greek).

having a poisoned spear-head at the other. A cord is connected with this log, and when the Hippopotamus treads on this, the log descends, plunging the poisoned spear into his body. Rifles and harpoons are often used, for you must know that the flesh of the Hippopotamus is much valued by the colonists under the name of "zee-koe speck," or "sea-cow bacon," as are also the tongue and the jelly extracted from the feet. The teeth, which weigh from five to eight pounds each, afford an extremely white ivory, which is used in the manufacture of scales of various philosophical instruments, and its hide, which is so thick that it has to be removed from the body in strips like so many planks, is used in making shields, whips, walking-sticks, and various other purposes.

The **Wild Hog,** or **Boar,** is the original from which the domesticated race of Pigs is descended. This group of animals is found in all the divisions of the globe, and although the wilder kind is now extirpated from Britain, of which it was formerly a native, it still ranges through the forests of France, Germany, and other parts of Europe, and boar hunting has in all ages been a favourite sport. The snout is longer and the tusks are larger than in those of the domestic Pig family, and it is by far stronger and more savage, but there are no other differences. The hogs do not restrict themselves to vegetable food, but eat flesh; it is said, however, that they do not kill other animals unless infuriated, but devour any such food which may fall in their way. They have two large middle toes covered by strong hoofs, and two at the side which are not long enough to touch the ground, but which, no doubt, serve to prevent the foot sinking deep into the muddy and marshy ground in which hogs love to wallow.

The **Tapir** is something like the Hog in shape, but its snout is prolonged into a short trunk, which it can use in breaking off the young branches of trees, fruits, &c., on

which it feeds; but it has not tne finger-like appendage which is seen at the end of the Elephant's trunk. Three species of the Tapir are known; two of which are natives of South America, and the other of the Islands of the Indian Archipelago.

It is very fond of water, to which it resorts when in danger or wounded; it is mild in its habits, but defends itself bravely with its teeth when attacked. Tapirs have four toes on their fore feet, and three on those behind.

The **Rhinoceros** (Fig. 15) is a large and powerful animal, and above all others seems to deserve the name "thick skinned;" for his skin is so thick, and so very hard, that the hunters have to employ bullets which have been hardened with tin, as ordinary bullets would have no effect. In fact, a spear will only pierce it in some parts which are thinner than others. Some of the species of the Rhinoceros belong to Asia and its islands, and some to Africa. The best known of these is the Indian. Almost every one has heard of the horn of the Rhinoceros, but it is scarcely correct to term it a horn, for it is not made of the substance known by that name, nor has it any connection with the skull, excepting that the bones under it are very strong and arch-like, to support its weight, and to resist the shock of the violent blows which the rhinoceros gives with its powerful weapon. This horn, then, is made up of hair-like fibres, closely matted together, forming a substance very much like that we call whalebone. The horn is scarcely visible in the young animal, and it takes several years to grow to its full size. The Rhinoceros is so very keen in its powers of smell and hearing, that it is a difficult thing to attack him; for when alarmed he retreats to his jungle, tearing up or trampling down everything before him; but when compelled to defend himself, he does so with great fury, using his horn with the most frightful effect.

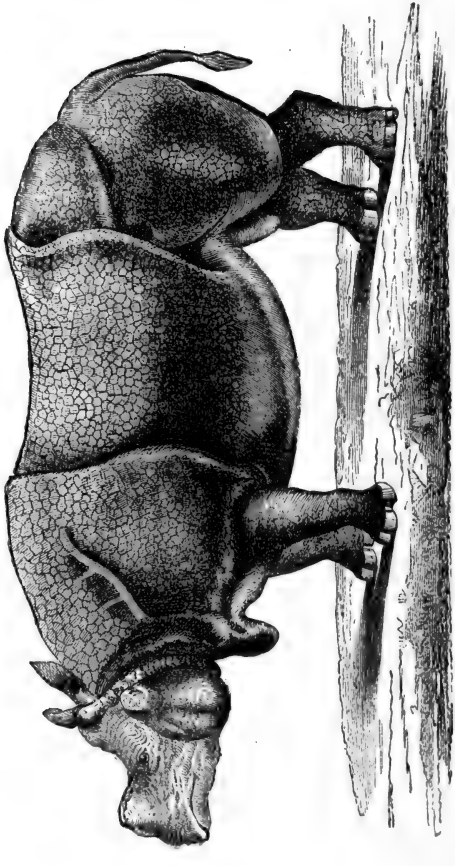


Fig. 15.

Another species, less powerful and savage, is found in Java; and a third, which possesses two horns, one behind the other, inhabits Sumatra. Four species belong to Africa, all of which have two horns. The Rhinoceros has three toes on each foot; and has seven molar teeth on each side, above and below, only four incisors, and not any canine teeth; nor does it require such, for it lives entirely on marshes, where it wallows in the mire, feeding on the roots of plants, which it ploughs up with its horn, and on the grasses and plants which grow in or on the banks of the water. Like the Elephant and Hippopotamus, the Rhinoceros was once an inhabitant of this country.

The last group of Pachydermata which we must now consider, is that called **Solidungula,** in which we find all the toes consolidated and enclosed in one hoof. This group contains only one family, of which the Horse, the well-known friend of man in every country, is the type; and all the members of the family are very much alike in general formation and habits. They consist of the Horse (Fig. 1) and the Ass, of which the Zebra, the Quagga, and Dzigguetai are various species. All these agree in the number and arrangement of their teeth. They have six incisors in each jaw, and six molars above and below on either side. These molars have square heads, on which the enamel stands up in curved ridges over the whole surface. The males have two small canines in the upper jaw, and sometimes in the lower, but these are not found in the females. A strange circumstance has enabled man to become the master of these powerful and useful animals; this is the peculiar arrangement of the teeth. There is a space between the incisors and molars which is totally devoid of teeth, and in this we place the "bit," by which we subdue and guide the Horse and the Ass.

Although the Horse has been employed by man from

the very early ages, the original stock from which he is derived is unknown; for even what they term Wild horses are believed to be descendants of animals which have been domesticated in former times, and which have subsequently become free. The Horse has its tail covered with long flowing hair quite up to its origin, which is one of the leading features which distinguish it from the other members of the family.

The Horse, noble and brave in its nature, has followed man into almost every country. Its docility, understanding, and affectionate nature have made it truly the friend of man, for whom it labours with all its strength, even until it dies under its burden.

The Ass (Fig. 16) is smaller than the Horse, and has a tuft of hair at the end of its tail. It seems to have been devoted to the domestic service of man before the Horse —which was employed in early times more for military purposes—and even at this day it is so used in some parts of the East, whilst the Ass is mostly employed in civil life.

The Ass is not naturally the rough-looking creature which we see harnessed in some of the carts about the streets of London. When treated with care and kindness, when properly fed and rubbed down, his appearance, and even his manners, are quite different. He cannot help that he is not a horse. He is always willing, quiet, and patient, and is it not cruel, nay, absolutely wicked to beat and ill-use him? How often do we see three or four persons get into the cart in which the poor donkey first fetched the stuff from market in the early morning, and has then dragged about all day? And not content with thus overloading and overworking the poor animal, they beat it and jerk the rein so as to inflict the greatest pain. But this is in most cases the conduct of ignorant men—of those who have never been taught the wonderful construction of animals, or to reflect on the wisdom and

mercy of God in placing them at the disposal of man; but it is more painful still to behold boys who have the advantage of such education, ill-treating them, and to see them mounted on the well-known donkey at the sea-side, kicking it with their heels, and beating it across its sides and back, or even urging the "donkey boy" to "make him

Fig. 16.

go faster" by the means which those poor and ignorant boys take—namely, striking it or "poking" it with a rough stick. Boys must remember that their having paid for the use of the donkey for the hour, does not give them any further privilege than the fair use of its labour, any more than paying weekly wages gives any master the liberty of beating or ill-using his servants; and that it is cowardly, and unworthy of the manly character which all boys should endeavour to attain, to illuse the poor dumb animals which are so entirely at our mercy.

The Ass is particularly sure-footed, and is, therefore,

much employed in ascending mountains in North Wales, and other mountainous districts. The author has been carried by one of these humble animals along narrow ledges of rocks, where there has scarcely been breadth enough for the donkey to move one foot in front of the other, and, by allowing him to take his own course, has reached the end of the journey in perfect safety.

The Ass is also much used by the poorer classes as a beast of burden, owing to the small cost of his food, for he will eat almost any sort of garbage; but he is very particular as to the cleanliness of the water he drinks.

The **Zebra** is a native of Southern Africa. His elegant form, and the ribbon-like stripes on his beautiful soft skin, make him one of the handsomest of animals; but he is so very fierce and untractable, that he has not been domesticated.

The **Quagga** is nearly allied to the Zebra, but is neither so large nor so handsome; its stripes only extending to the neck and shoulders.

The **Dzigguetai** is a species of wild ass, which is found in Mesopotamia, Persia, on the shores of the Indus, and in the Punjab. It is so wonderfully swift of foot that even the swiftest Arabian horse cannot overtake it; and hunting it is a favourite sport in Persia and in India. The Dzigguetai is not hunted for pleasure, but only for its flesh, which is deemed a great dainty. Its pursuers drive it towards rocky ground, and kill it with rifle bullets.

RUMINANTS.

RUMINATING animals are such as—(1) bring up the food which they have previously swallowed, in order to properly masticate it, a process which is termed "chewing the cud." (2) Have two toes, covered with separate hoofs, on each foot; and as these grow so close together, the foot

seems as if encased by one hoof, divided in the middle, and they are hence said to be cloven-footed. (3) They have incisor teeth only on the lower jaw, which work against a sort of hardened cushion in the jaw above, thus enabling them to crop grass and herbage from the ground, for all the Ruminants are distinctly herbivorous. Ruminants are divided into two groups—viz., those without horns, and those having horns, either in both sexes, or in the male only.

Ruminants without Horns.—These differ from the others in the formation of their stomach, in their teeth, and in their feet. They consist of the Camel and the Musk.

The **Camel,** which has been termed the ship of the desert, is indeed a most useful animal to the Eastern nations. Its feet are not cloven, and have lengthened toes and very small hoofs ; a flattened surface is thus formed, on the underneath part of which is a large soft sole or pad, covered with a hard skin. Its fore and hind limbs and its chest are furnished with pads, on which it rests when kneeling down. The peculiar construction of the thin feet enables them to travel over the sandy deserts with wonderful rapidity. Even with a weight of seven or eight hundred pounds they will travel at the rate of thirty miles a day ; but when bearing a man only, the swift Camel accomplishes from seventy to a hundred miles in twenty-four hours. The stomach of the Camel is not arranged as in the ruminants proper, but is specially adapted for carrying a great quantity of water—being divided into numerous compartments or cells—so that he can sustain life without drinking for ten or twelve days ; and if his food fails as well—if the poor wayfaring Arab cannot obtain for his hungering beast even a few beans or dates, and the scanty stock of cakes he brought with him is exhausted—even for this strait the kindly hand of nature

has provided; for, as the camel carries its drink in its stomach, he also carries food on its back, and the hump, which seems an incumbrance, now proves of real service, for the fat it contains is gradually absorbed into the

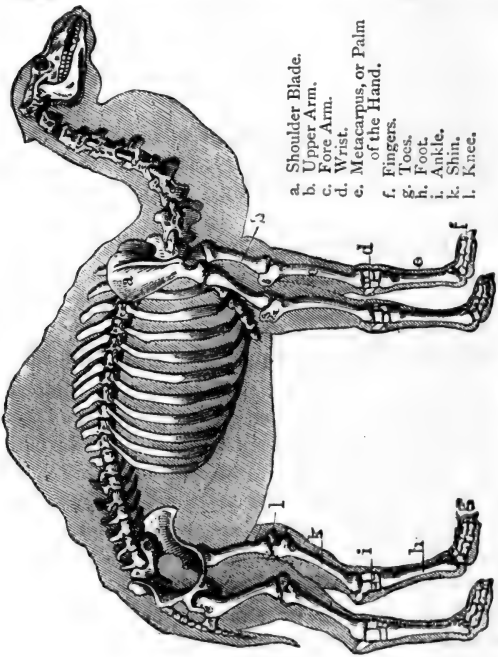


Fig. 17. SKELETON OF THE CAMEL.

system, and so serves to sustain it; thus, after a long journey, the hump is found to have grown sadly less, but recovers its size after a period of good feeding.

Many persons are in doubt as to the distinction between the Camel and the Dromedary, and it will, therefore, be well to tell them that there is no *real* difference. The

Dromedary is merely a lighter breed of the Camel, and is used for riding, whilst the ordinary Camel is employed as the beast of burden: the one is the hunter, the other the dray-horse. The Arabian Camel has one hump, whilst the Bactrian Camel has two.

The upper lip of the Camel is large and divided, and there are incisor and canine teeth in the upper as well as in the lower jaw; and as its neck is long, it is enabled thus to gather such scanty herbage as may exist in the desert; and, however withered or thorny, assisted by the water in its stomach, it can digest it.

Camels are represented in the new world by the **Llama,** but these are very much smaller, and have no humps, whilst their feet are so formed that they can climb rocks. One variety of the Llama is the **Alpaca,** which is a native of the Andes—from the Equator to Terra del Fuego. It is valued for its long woolly hair, which is straighter than that of the sheep, is very strong, does not break in combing, and has almost a silky texture.

The Musk.—This animal is something like the Deer in form, but is not so large, for, excepting the true Musk Deer, which is about the height of the roebuck, not any of them exceed the hare in size.

The true **Musk Deer** is a native of Central Asia, and is hunted in consequence of the male possessing a small pouch containing a substance known as *musk*, which is very valuable in perfumery. The Musk differs from the other ruminants in the absence of horns, in having long canine teeth in the upper jaw, and in having two additional toes at the back part of their feet. Their coat is covered with stiff bristle hairs, which stand out from the body, something like the spines which cover the hedgehog.

Ruminants with Horns.—Although this general term is used, it must not be supposed that the horns of all the Ruminants are of the same character, for they differ materially; and it is therefore necessary to divide them into two distinct classes; namely—*persistent*, or such as endure with the life of the animal; and *deciduous*, or such as fall off and are renewed annually.

Animals with persistent horns are divided into :—

(1) Such as belong to the group called "cattle," including **Oxen, Sheep, Goats,** and **Antelopes.** These horns are formed on a long core, in which are cells which communicate with the frontal bone of the head, and so receive air into their structure; this core is then covered with a case, made of the substance called horn, which is composed of hair-like fibres, and which increases by layers which are continually growing; these are called "hollow horns." In the Antelope, however, there are not any cells in the bony core.

(2) Such as the **Giraffe,** in which the horns are small and straight, and consist of a bony core, which, instead of being cased in horny matter, is merely covered with the hairy skin of the rest of the head.

(3) The deciduous horns are such as are possessed by the **Stag** family; they are formed of solid bone, and are called *antlers*, and are covered with a soft skin called the velvet. This *velvet* contains blood-vessels, which convey nourishment to the bony protuberances, and this supply goes on very rapidly and fast; but at last the channels become obstructed, and when no further nutriment can reach the antlers they die and fall off, or the animal breaks them off by striking them against a tree. In about twenty-four hours the wound is covered by a very thin skin; this becomes the velvet of the new antlers, which at once commence to grow. This takes place every

year; each pair of antlers being larger, and having more branches than the former ones. And it is a remarkable fact, that in the **Reindeer,** which inhabits the coldest

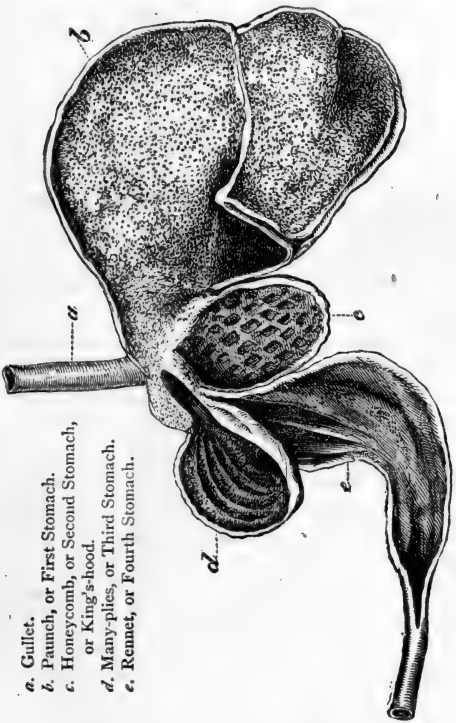


Fig. 18. THE STOMACH OF A RUMINANT.

a. Gullet.
b. Paunch, or First Stomach.
c. Honeycomb, or Second Stomach, or King's-hood.
d. Many-plies, or Third Stomach.
e. Rennet, or Fourth Stomach.

climates, the antlers are flattened, and are used by the animals as shovels to clear away the snow so as to find its food.

Let us now consider the operation of **Rumination,** and the construction of the organs by which it is carried on.

You must understand that, taken as a whole group, the Ruminants are timid creatures, and are but seldom aggressive unless infuriated. A great number of them are natives of tropical countries, where they are subject to the attack of wild beasts. Their only means of defence is their horns, and to use these, they must be able to face their foes, whose whole construction is such that they can spring upon the unoffending Ruminant and bury their claws and teeth in their back or sides. Their safety then must be sought in flight, and thus the construction of their stomach enables them to convey away with them a great quantity of hastily-gathered food, which they have the singular power of bringing up again into their mouths to be properly masticated. The annexed drawing of the stomach of a Ruminant (Fig. 18) will enable you to understand the processes through which the food passes during digestion. The grass, which is devoured in large quantities and swallowed hastily, passes down the *œsophagus* or *gullet* (*a*) into a very large bag called the *paunch* (*b*), or first stomach; here it is softened by means of the moisture and warmth with which it is surrounded, and it then passes into the second stomach, which, from its being divided into polygonal* cells, has been called the *honeycomb* stomach (*c*). You will no doubt be surprised at the small size of this second stomach as compared with the paunch, but you must remember firstly, that all the grass does not pass at once into the honeycomb, the paunch acting as a store-house; and secondly, that when vegetable matter has been soaked or boiled, it can be pressed into a much smaller compass than when raw. The cook will tell you that a whole lap-full of spinach, when boiled, only fills a moderate sized dish; well, then, in the honeycomb, the

* Polygon, a geometrical term for a figure having many sides. See "Right Lines," Cassell's Primary Series, page 81.

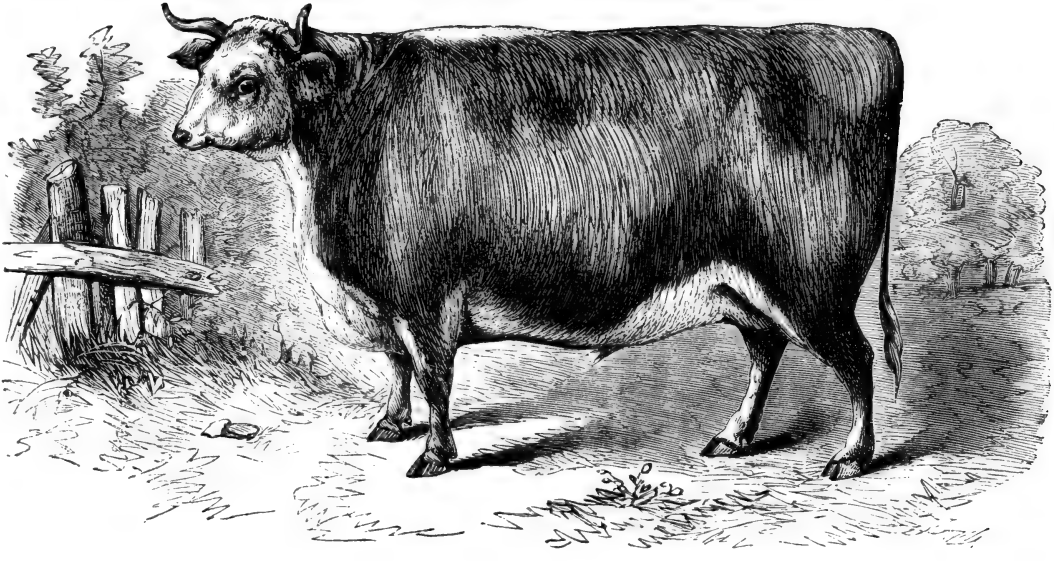


Fig. 19.—THE DEVON OX.

softened mass is squeezed into balls, and here it is further moistened, for all the water the animal takes passes directly into the second stomach. When the balls have been thus formed, they are forced back into the mouth; and when the animal lies in peace and quietness on the grass, it half-closes its eyes, looks as if it were thinking over the affairs of the whole nation, and then, by the peculiar motion of its jaws, which work from side to side, it grinds up the food which has thus been prepared. You must know that although there is a certain amount of nourishment in the vegetables we use for food, this is only of service to us when the vegetable has been soaked and heated, and therefore we *boil* them; but the ox eats the grass, soaks it, masticates it, and it goes towards forming its flesh; then we eat that flesh, and so receive the benefit of all the nourishment that can be extracted from the vegetable food the useful animal has eaten. This process, then, of "turning the matter over" is called rumination, or *chewing the cud.*

After the mass has been well ground down by the teeth, it is again swallowed, and this time it passes into the third stomach, called the *many-plies* (*d*)—which, as you will see in the drawing, has a number of folds—and thence it passes into the *rennet*, or fourth stomach (*e*), in which the true digestion takes place; and it is on account of the peculiar acid which exists in the membrane of this organ, that it is employed in dairies to obtain curd from milk in the process of cheese-making.

The animals comprehended in this group are by far too numerous for illustration, and, therefore, two only are given; namely, a Devon Ox (Fig. 19), and a Fat-tailed sheep (Fig. 20). This last-named animal is a native of Syria and Egypt, but is found in many other parts of the world. In this species the fat accumulates to such an extent that the tail weighs from fifty to eighty, or, as

Fig. 20.—THE FAT-TAILED SHEEP.

some say, a hundred pounds. This animal is, as you can well understand, carefully tended, for of course such quantities of fat are valuable, being used for tallow in the manufacture of soap, as butter, or to "lard" meat that would otherwise be dry and tasteless. In order, therefore, to assist the animal in drawing such an enormous tail behind it, the shepherds fasten a board under it, and sometimes add wheels, so that the tail may be carried on a little cart, as shown in the drawing.

The stomach of Ruminants is not the only portion of their construction which is adapted to their habits. Their eyes are placed at the side of the head—not in the front—so that they can see almost as far behind as before, and the pupil or black central part is elliptical in form, and is placed horizontally, so that they may be able to see around them in a wide circle of vision; whilst in animals of the tiger tribe the pupil is formed like an ellipse, placed in its narrow end, so that the animal whose habit it is to spring on their prey have their circle of vision extended in an upward direction; whilst in man, to whom is given dominion over the beast of the field and the fowl of the air, the pupil is circular, so that he can see around him in every direction. The ears of Ruminants, too, are placed far back, and are very movable, so that they can be quickly turned to catch sounds coming from any direction; and their sense of smell is also particularly acute.

Oxen are, of all animals, those which are the most serviceable to us. While alive, the male draws the plough and performs other hard labour for us, whilst the female yields the best milk, of which we make butter and cheese. When, after being fattened, the ox is slain, its flesh, liver, and heart are the staple articles of our food, and every portion of the animal is useful to us. His blood, his horns, hoofs, skin, hair, fat, bones, and intestines, are all manufactured into articles which supply our daily wants.

UNGUICULATED MAMMALIA.

Edentata, or Toothless Animals.

ALTHOUGH the general term "toothless" is given to the animals forming this order they are not all of them *wholly* devoid of teeth; in fact, some of them have a great many. They all, however, agree in this one particular, namely, that they are *all entirely without incisors.*

They may be divided into Leaf-eating and Flesh or Insect-eating.

The first of these tribes is represented by

The **Sloth,** which belongs to a family named *Tardigrada,* or slow-footed. This animal has been much misunderstood, and even pitied by several naturalists. Even Cuvier says, "Nature seems to have *amused* herself in producing something imperfect and grotesque." Now in this Cuvier was most absurdly wrong. Nature never *does* amuse herself—the works of God never *are* imperfect; it is only our knowledge of them which is so defective, that we are not able to see the wise provision which the merciful Father of all has made for the well-being of His creatures. The fact is, that those who have reported on the Sloth have observed him when, by some accident, he has been upon the *ground;* but the sloth never *is upon the ground if he can help it.* He lives amongst the *trees,* but not, as monkeys and other arboreal* animals live, *on* the branches, but *under* them; and, therefore, his construction is adapted for hanging *from* the boughs. His legs are very strong, and those in the front—that is, his arms—are twice as long as the hinder ones, and all four turn *inward,* so that when on the ground he is of course awkward; but once on, or rather *under* the branches of a tree, he gets along with a

* Arboreal—belonging to trees. From the Latin word *arbor,* a tree.

speed which shows that he is anything but slothful. The teeth of the sloth are not adapted for grinding, but only for bruising its food, which consists of tender buds and

Fig. 21.—THE SLOTH.

leaves. It has, however, a very peculiarly constructed stomach, divided into several compartments, something like that of Ruminants, and in this the crude vegetable matter is thoroughly digested.

The Sloth goes to sleep at night in a way which would

not be very agreeable to children who are accustomed to seek the downy pillow. When the "dustman comes in their eyes" they take their place at the fork of a tree, their arms embracing the trunk, their back resting upon the angle of the branch, and the head bending forward upon the chest, buried in the long hair, or rather wool, of the chest, and so protected from the numerous insects which would thus attack it.

Flesh or Insect-eating Edentata may be divided into the Loricata, or shielded animals, and the true Edentata.

The shielded animals comprehend the Armadillo and

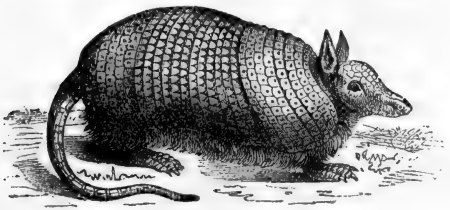


Fig. 22.
THE ARMADILLO.

its relations. This animal is covered with a series of shields, made of a horny substance, which form bands over the back, so that it can move with all the freedom it requires. Armadillos are famous diggers, their claws being large and strong, and they dig such deep holes, and hold so fast to them, that they have been known to leave their tails in the hands of hunters, who have thus caught them, and who have thought that now they have them quite safely; and when unable to get to their holes, they roll themselves up like a ball, defended entirely by their coat of armour. Their teeth are not very strong, but they do not require such, their food consisting chiefly of insects, worms, and fallen fruits. It has already been

mentioned that they have no front teeth, and the back teeth are curiously placed, for instead of being over each other, they are placed alternately, so that when the Armadillo closes its mouth, the teeth in the upper jaw come down into the spaces between those in the lower jaw, and you can very well imagine what would happen to any poor worm whose adverse fate may have brought it within range of this crushing machine. In the early days of the world there were some tremendous Armadillos. You can see the armour of one of these, called the Glyptodon, in the Museum of the College of Surgeons, London. The largest now known to exist is the Great Armadillo, which is sometimes three feet long, but some others are much smaller. They are natives of South America.

The **Ant-Eaters** are the true Edentata, for they do not possess a vestige of teeth. There are two families of them—the Ant-eater of South America, and the Pangolin, or manis, of Africa and Asia. The Ant-eater is coated with coarse rough hair, and has an enormous bushy tail, whilst the pangolin is completely covered with horny scales, and his tail seems like his body lengthened out. The Ant-eater, as his name implies, lives on Termites, or white ants, which, you know, make their nests in the shape of large hills, and in great numbers. Well, the Ant-eater, whose claws are specially adapted for the purpose, tears a portion of the dwelling away, and intrudes his long-pointed nose ; then he puts out his tongue, which is long, and like a large worm, and which is covered with a sticky liquid. The Ants come and settle on this, and are glued to the surface ; the tongue is then drawn in, and the Ants—but I need not tell you what becomes of them. The Ant-eater, when in danger, doubles its head on its breast, crouches down all of a heap, spreads its tail over its body, and looks then very much like a hay-cock, which you have seen in the fields.

Fig. 23.—The Great Ant-Eater.

RODENTS.

THE Rodents, or gnawing animals, form a very numerous order—so numerous, indeed, that half of all the Mammalia known belong to them. They are all of a small size, the largest being the **Capybara,** a native of South America, which is about the size of a small pig. The chief peculiarity of this group of animals is the construction of their teeth, which differ from those of all other animals. You must know that although some of them, such as the **Rat,** can eat almost any sort of food, still most of them are herbivorous, and live upon the harder sorts of vegetable matter—the bark, roots, and stems of trees—and you know how fond **Squirrels** are of nuts, and how they chip and chip away at the shell until they get to the kernel; and how **Rats** and **Mice** work their way through the floors of cupboards, much more cleverly than we like. Well, you must understand that they are enabled to do this by four large and strong front teeth—two in each jaw, which project and meet like two pairs of chisels; but I dare say you have noticed that when a carpenter has been working in hard wood he is obliged to take his chisel, firstly, to the rough circular grind-stone to grind a new edge to it, and then to the oil-stone, which he carries in his basket, so as to get the edge fine and smooth. Now, although the **Beaver** may have spent hours and hours in cutting off the branch of a tree to use in building its dam, and although the Squirrel may have worked industriously all day at nut-cracking, and although little master mouse may have devoted much time and labour to boring a hole in the wainscoting of a cupboard, so as to get at the cheese or "goodies" which may be there (for which exertions we show our gratitude by detaining the clever little gentleman)—still, the teeth of these four-legged carpenters never require sharpening; and the reason is that whilst the

enamel in most other animals covers the whole crown of the tooth, it is only placed in the front of those of rodents, with the ivory at the back, so that, when the animal works at its trade, the softer part wears away, leaving the front or harder portion standing sharply up; and further, as these hard edges get worn away a little by working against each other, the teeth continue growing, so that they are always kept of the proper length. The back teeth are flat, with ridges of enamel, which in those

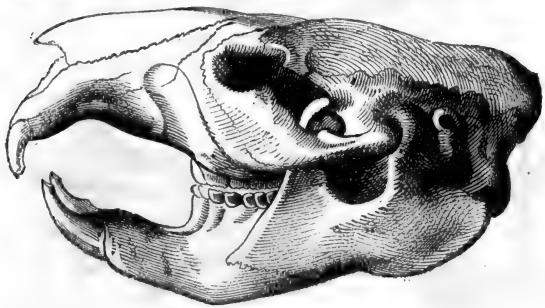


Fig. 24.—SKULL OF A RODENT.

rodents who live on vegetable matter are rounded, whilst in the others they are sharp. The Rodents, too, have the power of moving their jaws backward and forward, so that the teeth work on each other like rasps or files.

The Rodents may be conveniently divided into—those which possess collar-bones, and those which are without them; and as the collar-bone acts as a sort of buttress to support the shoulder against the top of the breast-bone, you will not be surprised to find amongst the first such animals as use their front legs, not only for walking, but as arms in the hard work they have to do, such as the Beaver, the Squirrel, and the Rat, and amongst the latter the **Porcupine, Hare,** and **Guinea-pig.**

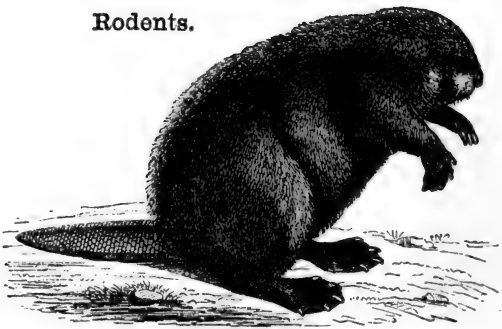


Fig. 25.—THE BEAVER.

Fig. 26.
BEAVER'S HAND.

Fig. 27.—BEAVER'S FOOT.

Fig. 28.—THE SQUIRREL.

The three principal families forming the first section may be distinguished by the form of their tails, which in the Beaver (Fig. 25) is broad and scaly, in the Squirrel (Fig. 28) is large and bushy, and in the Rat is round and scaly.

Every one has heard of the building powers of the **Beaver;** how he cuts off boughs of trees, makes a dam, and builds a large and commodious house ; but before he uses the wood he carefully strips off the bark, and lays it up for food. Many of these animals, as the Hamster, the Squirrel, the Dormouse, &c., have this same useful habit of storing up provision for the future.

The **Hamster** (Fig. 29) is provided with check-pouches, which he fills with grain, and then trots off to deposit it in his warehouse. Some of the rodents *hybernate*—that is, they sleep over the winter. Thus, the **Marmots** (Fig. 30), of the Alps and Pyrenees, prepare a couch of grass in their nest, and make a ball of hay, which they place at the mouth of their burrow ; they then go in *backwards*, drawing the ball in by their teeth ; they thus effectually close or cork up the opening, and make themselves cozy and warm, from about September to April.

The **Porcupine** (Fig. 31) is a strange-looking animal. It seems to owe its name to our French neighbours, who, in consideration of its heavy, pig-like appearance, conferred on him the polite designation of porc-epin—a spiny hog. Some people call these spines *quills*, but this is a mistake, as they are nothing more than enormous hairs, which the animal can erect when it chooses. The Porcupine has its head covered with a bristly sort of mane, and has some strange hollow quills on its tail, which make a noise when they strike against each other. As a rule, this animal only comes out at night, lying concealed all day, and becomes quite torpid in the winter.

Fig. 29.
THE HAMSTER.

Fig. 30.—THE MARMOT.

Fig. 31.—THE PORCUPINE.

CARNIVORA.

THE name given to this order of Mammalia is quite explanatory of the mode of life of the animals so termed. It is derived from two Latin words, which mean "flesh-devouring," and, as you have already been told, their teeth are particularly adapted for obtaining and masticating their food. Thus, in the Feline or Cat race—which are the most ferocious and blood-thirsty of the whole order—there are four long sharp fangs in the front of the mouth, which the beasts of prey belonging to this group strike into the bodies of the unfortunate animals they pounce upon; these are called Canine teeth, and between these are six sharp incisors in each jaw, and the molar or side teeth are flat on one side, and have sharp edges notched like the teeth of a saw; these work against each other, and so chop up the flesh like a large pair of shears would do.

The Carnivora are divided into—

Plantigrade, or such as walk on the soles of their feet.

Digitigrade, such as walk on their toes only.

Amphibious, such as are adapted for spending part of their life in water; and

Insectivorous, or feeding entirely upon insects.

Fig. 32.

FRONT FOOT OF A BEAR.

Fig. 33.

HIND FOOT OF A BEAR.

Plantigrade Carnivora.—The **Bear** tribe fully represent these, as they put their whole sole upon the ground, and are able to raise themselves upon their hind feet. They have thus been taught to walk on two legs and to dance—a cruel thing, as it is evident that nature never

Plantigrade Carnivora.

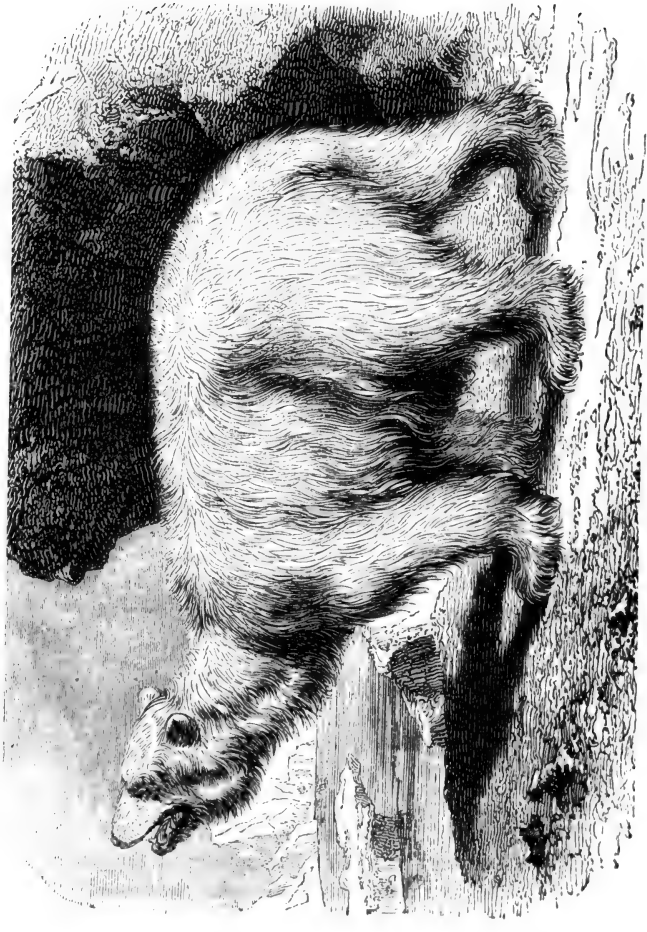


Fig. 34.—THE POLAR BEAR.

intended Bears to do this. The Bear rises up in an erect posture when defending itself with its front paws, and if it manages to get hold of its foe it gives it a hug which, though very close, is anything but friendly.

Figs. 32 and 33 show you the soles of the feet of bears, and if you contrast them with the foot of a Lion, which you will meet with further on, you will at once see how differently they are formed. Fig. 34 is a drawing of a **Polar Bear,** one of the species which lives in the most frozen regions of the world. He can swim and dive in a wonderful manner, and buries himself in snow, or huddles up in some cleft in a huge mass of ice, and so passes his winter.

Bears are not quite as carnivorous as the other members of the order, for, although they take animal food when they can get it (the Grisly Bear of North America attacks and even vanquishes the Bison, and the Polar Bear devours fishes, portions of Whales, &c.), still they all eat vegetable substances, and the Polar Bear will devour mountain berries, sea-weed, &c. Their molar teeth are adapted for crushing instead of cutting.

Racoons are very much like bears, but are smaller, have longer tails, and can climb better. They sleep all day and prowl about near the margin of rivers, swamps, and the sea-shore at night. They have the strange habit of never eating anything until they have dipped it in water, and are particularly clever in opening oysters. The **Badger** and **Glutton** also belong to the Plantigrade Carnivora.

The Digitigrade Carnivora.—The Digitigrade Carnivora are divided into—Cats, Hyænas, Civets, Dogs, Polecats, Martens, and Otters.

Cats.—At the head of the Feline or Cat-tribe, stands the **Lion,** Fig. 35, which, indeed, is a worthy representative of the tribe. The claws of all the members of this

Digitigrade Carnivora
(Walking on Toes).

Fig. 35. — THE LION.

Fig. 36.—THE SKULL OF A LION.

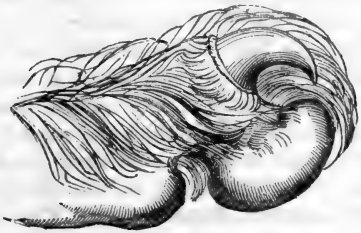


Fig. 37.

CLAW OF LION, SHEATHED AND UNSHEATHED.

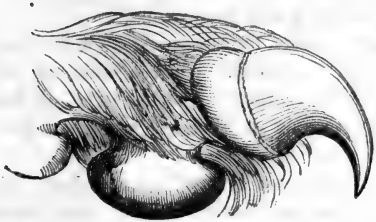


Fig. 38.

family are retractile—that is, they can be drawn in when the animal is walking, and extended when required for active service. Did you never shake *hands* with pussy when she has her gloves on? If you were to try to do the same just as she is about to spring on a rat or mouse, you would not find the paw *quite* so soft and velvet-like; this is because the claw is drawn in by a muscle and doubled under the foot; and further underneath the foot the feline animals have a soft elastic cushion—that black India-rubber-like pad—which enables pussy to come into a room without being heard, or to walk about amongst the crockery on the shelves of a cupboard without breaking a single thing. Then, again, did you ever look at a cat's tongue? It is covered with little prickles which bend backwards, and, of course, in the larger species these are very strong, so that the animals can scrape off the flesh from bones as with a rasp. All these animals have skeletons which are wonderfully elastic, and still very strong; this is in order to enable them to spring with ease, and to squeeze through very narrow openings in hedges, thickets, and other places through which they pursue their prey; and their eyes have been already described. This group includes the **Lion, Tiger, Panther, Leopard, Jaguar, Lynx, Cat,** &c.

Fig. 36 is the skull of a Lion, showing the form of teeth of carnivorous animals. Figs. 37 and 38 show the lion's claw when sheathed and unsheathed.

The **Hyænas** have only four toes on each foot, and their claws are not retractile. These animals feed principally on dead prey; they come out at night from their homes amongst ruins or caverns, and then prowl about, eating anything they can find

The **Civets** are natives of Africa, but are found also in Holland, which country carries on a considerable trade in a perfume obtained from these animals. The

Civets are a sort of connecting link between Cats and Dogs.

The **Ichneumon** is one of this family. It was worshipped by the Egyptians, and the people were forbidden to kill it, because it kept down the number of crocodiles by devouring their eggs, which it scratched up out of the sand. It is frequently domesticated in Egypt, as it keeps the houses clear of rats and other vermin ; and a smaller species is also employed in India for the same purpose.

Dogs.—These animals are so well known that it is scarcely necessary to describe them. They have been properly called the "friends of man," for they have accompanied him over the entire world. The honest, faithful, and affectionate disposition of this animal renders it the faithful companion of its master in every country. Nor is the dog's affection dependent on interest, for the rough cur that so carefully leads the blind beggar, refusing to run away and play with the others he passes, and who seem earnestly to invite him, is as content with the dry crust, or with the bare bone, off which his poor master has already scraped all that could be obtained, as the well-kept and petted spaniel is with the dainty food its kind mistress has provided it. Dogs have five toes on their front feet, but only four on the hinder ones, and, as you know, their nails are not retractile.

Wolves, though they belong to the dog-family, are very different in their habits and disposition. They are ferocious, sullen, and cowardly. They unite in packs, and attack cattle and sheep, but they seldom venture to assail animals of their own size and strength. Dr. Carpenter gives the following Russian Government report of the depredations of Wolves in Livonia—a tract of about 250 miles long and 150 broad—in the year 1822 :—"Horses, 1,841 ; cattle, 1,807 ; calves, 783 ;

sheep, 15,182; lambs, 726; goats, 2,545; kids, 183; swine, 4,190; young pigs, 312; dogs, 703; geese, 673; fowls, 1,243." Happily, these savage brutes have been extirpated from England since 1281; but it is stated that they existed in large numbers in Scotland until 1577, and in Ireland until the beginning of the last century.

The **Jackal** partakes of the habits and appearance of both the Wolf and the Fox; it attacks animals smaller than itself, but, as a rule, feeds on carrion and offal of every description.

Foxes differ from Dogs and Wolves by their large bushy, or rather "brushy" tails, and in their muzzles, which are narrower; they resemble the Cats by their elastic and comparatively light skeleton. Their eyes, too, are like the Cat's, as the pupil in the day-time is a narrow vertical ellipse. "As sly as a fox" is, you know, an old saying, and he is cunning indeed. There are not many of them now in this country, and there would be less still were it not that some are preserved to afford sport for the huntsman.

The **Polecats** constitute a group of the Digitigrade Carnivora, called *vermiform*,* because their bodies are so very long and thin, and their legs so short. Besides the common Polecat, this group comprehends the **Ferret,** the **Weasel** (Fig. 39), the **Ermine,** the **Marten,** and the **Skunk.** All of these prey on smaller animals, particularly rats, mice, and birds; but they also feast on the eggs, if they do not happen to "come across" the birds themselves. In the summer the Ermine wears a beautiful brown coat, but in winter he changes it for pure white, the tail being just tipped with black. Ermine is procured from most countries in Europe, but the best skins come to us from Norway, Sweden, and Russia.

* *Vermes*, a worm

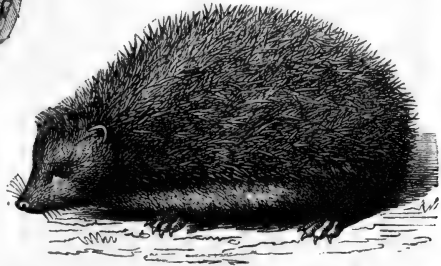
Fig. 40.—**Amphibious Carnivora.**

THE SEAL.

Fig. 39.—**Vermiform Carnivora.**

THE WEASEL.

Fig. 42.—**Insectivora.**



THE HEDGEHOG.

The robes and crown of the Queen and Royal Family, and the state robes of the Peers are adorned with Miniver—this is the white skin of the Ermine—powdered or studded all over with black spots, made from the skin of the black Astracan lamb, and the arrangement of the spots shows the rank of the wearer.

Ermine, with the black tails of the animals, is also much used by ladies for muffs, tippets, &c. In the present free and happy period we dress just as we like, but it was not always so; and thus we find that in the reign of Edward III. none but members of the Royal Family were allowed to wear ermine. We import upwards of 100,000 Ermine skins into this country every year.

The skin of the **Sable Marten** is, however, of the highest value; although it is small, its price is from three to fifteen pounds each; and hunting the animal is one of the most difficult and dangerous of enterprises. The animal lives principally in the wilds of Siberia, and the Russians, having great necessity for furs, know full well the value of the sable-skins, so that about 25,000 of them are annually sold in that country, whilst between 2,000 and 3,000 are brought to this country. The Lord Mayor, Aldermen, and Sheriffs of London have their robes lined with sable; and some of the best brushes used by artists are made of the hair from the tail of this animal.

The **Skunks** are termed "mephites," which word means a noxious exhalation, for they emit a horrible smell, which diffuses over a great distance. The whole of the polecat family emit a most disagreeable odour, but the Skunks surpass all their relations in this respect.

The **Otter** seems to lead us to Amphibious Carnivora, for it lives principally on fish, after which it swims and dives in an exceedingly easy and swift manner. It has, in fact, been tamed, and used for catching fish. The Otter is still found in the British Isles, and we send about 500

skins annually into the market. But America sends us about 20,000, and of these we sell about 16,000 to other countries.

The **Sea Otter** conducts us a step nearer still to Seals, for it lives almost entirely in the water. It is a native of Behring's Straits and the neighbouring regions, frequenting the sea-washed rocks. The animal is very scarce, and its skin is much prized ; it is jet black, with a silvery appearance at the end of each hair. A fine skin of the sea otter costs about forty pounds, and a muff of it costs twenty-five guineas.

Amphibious Carnivora are adapted for life in water; in fact, they seldom come on shore but to lie in the sun, or to nurture their young. They may be divided into **Seals** and **Morses.**

From the engraving of the **Seal** (Fig. 40), you will see that these are absolutely four-footed animals, with shoulder-blades, arms, legs, fingers, and toes just the same as other quadrupeds. Like the Whale, the Seal has its front paws covered with flesh and skin ; but you will remember that the Whale has only front limbs, and *not any hinder ones*, whilst the Seals have hind feet perfectly formed, bending backwards.

The **Seals** are most docile and affectionate, resembling dogs in the expression of their faces, and also in their mild disposition. They exist in the Arctic Seas, and form the principal support of the Greenlanders and Esquimaux, who eat their flesh, and use their fat for both lamps and fires : they cover, firstly their bodies, and then their boats with the skins, and sew with the fibres; they even use the intestines for numerous purposes. We import about 600,000 or more seal-skins into this country, and as recently "seal-skin jackets" have become fashionable amongst ladies, we shall, no doubt, soon require many more. The teeth of Seals are sharp and jagged, their

Fig. 41.—AMPHIBIOUS CARNIVORA.—THE WALRUS, OR MORSE.

points turning backward, which enables them to hold their very slippery prey.

The **Morse** is, perhaps, better known by the name of **Walrus** (Fig. 41), or Sea Cow; but this last is not a correct name, for Walrus really means a **Whale-horse**; though it is difficult to say why even this term has been applied, considering that the animal bears no resemblance to the horse. Although a Seal in all its habits, its form is by far more bulky, and more of the shape of land quadrupeds: its teeth are quite different; in fact, the two canine teeth of the upper jaw grow to an immense size, and form tusks like those of the Elephant, about two feet long; but whilst the Elephant's tusks are directed forward, those of the Walrus are turned directly downward, and the animal thus uses them not only as a means of defence against the attacks of the Polar Bear, but of progression: for he strikes them into the rocks in climbing out of the water, which, you can well understand, is no small matter, for his body surpasses that of the largest ox in size, and by their means also he is able to tear up the immense masses of sea-weeds on which he feeds.

The Walrus is pursued on account of its oil and its tusks, which yield ivory.

INSECTIVORA.

ALTHOUGH several of the animals belonging to other groups of Mammalia live on insects, still in this order we find the whole construction specially adapted for such prey; and when we remember the infinite number of insects, and the rapidity with which they increase, we shall again be led to feel gratitude for the creative wisdom which has provided special agents for checking the legions which might otherwise become unbearable.

There are three principal families of Insect-eating animals—

The **Moles**, the Hedgehogs, and the Shrews.

Of course you know that Moles burrow deeply in the ground, and seldom come out of their tunnels. Indeed, they are awkward-looking things enough when out of their sphere, for their limbs are so very short, that they scramble rather than walk along. And these limbs seem all *hand*—the bones forming the arms being very short and thick, whilst the claws are immensely strong. The Moles, although very quiet-looking, are really very savage, and fight with each other most furiously. One has been known to bite its captor so fiercely, that it was only compelled to loosen its hold when squeezed nearly to death by the teeth of its antagonist; another flung itself on a young lady's neck, and inflicted a severe wound.

The eyes of the Mole are very small indeed, and it does not seem able to bear the light of day; but its sense of smell is very great.

The **Hedgehog** (Fig. 42) is too well known to need description. The spines or prickles with which it is covered are erectile—that is, the animal can either allow them to lie down with their points directed backwards, or, by a peculiar motion of the skin, can cause them to stand upright like the bayonets of so many soldiers; and when in danger, it can roll itself up like a ball, which is so prickly that it requires some courage to take hold of it. These animals feed on insects, frogs, slugs, &c.; and is so useful in destroying cockroaches, that it is kept in many London kitchens for that purpose. It generally hides under the copper or in some close cupboard all day, and, coming out at night, wages war against the black-beetles, of whom it eats so many, that it is frequently found dead from the consequences; for you can imagine

that the hard coating of the beetles is not very digestible, especially when taken in such great quantities

Shrews are something like mice in shape and in their fur—so much so, that they have sometimes been called the "shrew-mouse." A sort of musky smell proceeds from their body, so that, although cats will kill, they do not eat them; but weasels, hawks, and owls are not so particular. The shrew has a long, movable snout. In fact, one of the family is called the "Elephant-shrew," because its nose is elongated like the elephant's trunk in miniature; and another, called the "Desman," has his nose longer still.

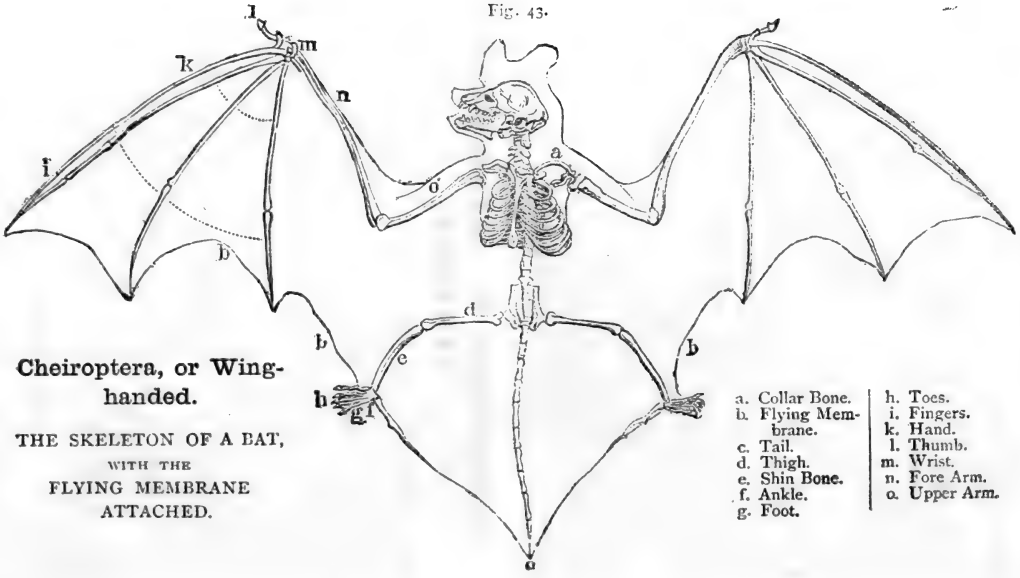
Most of the Shrews frequent water or its neighbourhood; and the Desman spends most of its time in or on the banks of streams, and tunnels its home in the banks, the entrance being under the water, so that it can escape into it on the appearance of danger.

CHEIROPTERA, OR HAND-WINGED MAMMALIA.

THE Cheiroptera* or Bat tribes are distinguished from all other Mammalia by their power of flying. Their progression is, however, performed by an apparatus entirely different from that of birds, consisting of a very thin membrane spread over the entire body. The principal support of this membrane is formed by the four fingers, which are immensely elongated (see Fig. 43); and over these the skin is stretched precisely as the silk is spread over the ribs of an umbrella. The thumb stands out free, and is terminated by a hooked claw. The hind legs and tail serve to assist in keeping the flying-membrane spread out; the tail serving as a rudder. The breast-bone, like

* *Cheir*, the hand; *pteron*, a wing.

Fig. 43.



Cheiroptera, or Wing-handed.

THE SKELETON OF A BAT, WITH THE FLYING MEMBRANE ATTACHED.

a. Collar Bone.
b. Flying Membrane.
c. Tail.
d. Thigh.
e. Shin Bone.
f. Ankle.
g. Foot.
h. Toes.
i. Fingers.
k. Hand.
l. Thumb.
m. Wrist.
n. Fore Arm.
o. Upper Arm.

that of birds, has a sharp, keel-like ridge for the attachment of the muscles which are to move the arms; and the shoulder-blades and the collar-bones, which serve to keep them apart, are both very strong.

Bats are divided into several families, some of which

Fig. 44.
HEAD OF VAMPIRE BAT.

live on fruits, others on insects, whilst a third group live on the blood which they suck from other animals, and, as in the other Mammalia, the teeth are arranged accordingly. Thus, in the **Spectre Vampire**—the head of which is annexed (Fig. 44), the molar teeth have pointed tubercles, between which the hard coating of insects is readily crushed; whilst the sharp canine teeth serve to

seize the prey, as they do in the feline race. Again, in the Vampires which suck blood, these teeth are like sharp lancets, with an open space in the middle of the lower jaw, into which two sharp incisors close, and thus a triple

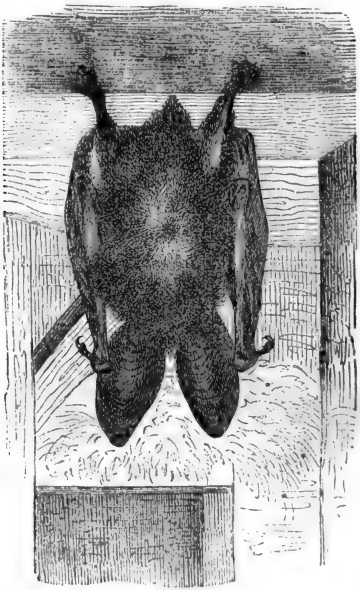


Fig. 45.
BAT SLEEPING.

wound is inflicted; in these the molar teeth are very imperfect, and are unfit for grinding.

Owing to the wide membrane with which they are surrounded, Bats can only walk with great trouble, and can scarcely start on their flight if placed on the ground. They therefore sleep in the daytime, hanging by their feet

(Fig. 45); in this position, too, they remain in caves, ruins, or some out-of-the-way place during the whole winter. Some bats have a large leaf-like appendage on the front of their nose, as in Fig. 44, whilst others are without it; and some are noted for the extraordinary size of their ears.

QUADRUMANA,* OR FOUR-HANDED MAMMALIA.

THE term "four-handed" is by no means a correct one, as we do not find a thumb separate from the other fingers in all four extremities of every member of the group; for in some, only one pair are so provided, and that the *hinder* pair. But as the feet are always so formed, it would be more correct to call the whole order "Pedimana, or hand-footed," since all can use their feet as hands, but *all* have not *four* hands. The hands of the Quadrumana differ materially from those of man. The fingers are long and slender, and the thumbs so short, that their tips can only with difficulty be brought together, so that they would be wholly unfit for the manifold and refined operations performed by the human hand. They are, in fact, *claspers* more than hands, which enable the animals to climb trees or to suspend themselves from the boughs. Nor can the foot of even the Chimpanzee, Gorilla, or Orang be compared with that of Man; for they cannot plant it *flat* upon the ground, but walk upon its outer side. The toes are longer and more separated than in the human foot; and the great toe (Fig. 46) is converted into a thumb, and stands off from the side, thus making the foot of the quadrumana a grasping rather than a walking instrument; whilst, owing to the very slight extent to which the heel-bone projects in the Apes, the muscles of the calf,

* *Quatuor*, four; *manus*, a hand.

Fig. 46.—THE CHIMPANZEE.

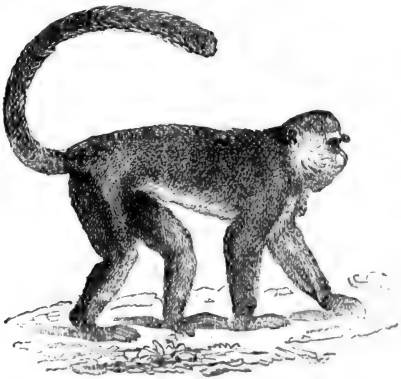


Fig. 47.—THE MONA.

so largely developed in man, cannot act on the leg with equal power, and hence these animals cannot keep upright long, but soon seek the aid of some friendly branch as a walking-stick, or, failing this, are compelled to walk on their feet and knuckles.

Quadrumana may be divided into—

SIMIADÆ,
CEBIDÆ, AND
LEMURIDÆ.

The **Simiadæ** include Apes, Monkeys, and Baboons of the Old World. These are omnivorous, and have the same teeth as man.

The **Cebidæ** are the Monkeys (Fig. 47) of the New World, and these have usually an extra molar tooth on each side, making thirty-six in all.

The **Lemuridæ** are confined principally to Madagascar. In most of these the teeth are irregular in their number, and they have a claw on their first finger.

Apes are known by their having neither tails nor cheek-pouches. Some have hard patches, called callosities, on their hinder limbs ; others are without these.

Monkeys have cheek-pouches, callosities, and long tails, and habitually walk on all four feet, using their tail as a balancing pole.

Baboons are distinguished from apes by their cheek-pouches and callosities, and differ from monkeys in their extremely short tail.

BIMANA, OR TWO-HANDED MAMMALS.

OF the class Bimana, man is the only representative, as he is the type of all that is perfect in creation, endowed with the power of speech, and all other gifts calculated to fit him not only for a life on earth, but with mental and

moral attributes by which he can raise his thoughts and aspirations to a world above. It is not intended to enter here on the study of Human Physiology; an elementary treatise on this subject has already been issued,* and further instruction will be given in a future volume.

BIRDS.

THE second great division of the Vertebrata comprehends animals whose fore limbs are converted into wings, by which they are enabled to fly in the air. Their whole structure is of exceeding lightness: the air not only enters their lungs, but is conveyed to the interior of their bones, and thus assists them in rising and in sustaining themselves in the atmosphere.

Their blood is hot, and very rapid in its circulation, and it is this which renders them so peculiarly active. Their covering, too, adds but little to their weight, for every feather contains air.

Birds are entirely devoid of teeth. Those that feed on flesh have a very strong and sharp beak, which in some cases is jagged at its edge, so that they can cut or tear their prey; those which feed on grain have a hard muscular stomach, called the *gizzard*, in which the food is ground by the gravel, &c., which the fowl has swallowed. The beaks and feet of birds are as wonderfully adapted to their modes of life as are the teeth and feet of mammalia; and as they vary in every order, they will be described in their proper places.

The collar-bones unite in the form somewhat like the letter V, and make up the bone known as the *merry-thought;* this keeps the shoulders well apart, and affords support to the socket in which the bones of the wings work. Their eyes are protected by a third eyelid, which moves

* "Our Bodies," Cassell's Primary Series.

Fig. 48.
SKELETON OF A BIRD.

a. Vertebræ of the Neck.
b. Collar Bones united in Merrythought.
c. Breast Bone.
d. Thigh Bone.
e. Leg Bone.
f. Instep.
g. Toes.

Fig 49.
NICTITATING MEMBRANE.

vertically across the eye, and protects that organ from injury in flying amongst foliage; but being semi-transparent, the sight is not obstructed.

Birds are divided into—

Raptores . .	Birds of Prey,	as the	Eagle.
Passerines, or Insessores .	Sparrow-like, or Perching .	„	Sparrow.
Scansores . .	Climbers . .	„	Parrot.
Rasores . . .	Scratchers .	„	Turkey.
Cursores . . .	Runners . .	„	Ostrich.
Grallatores . .	Stilt Birds .	„	Heron.
Natatores . .	Swimmers .	„	Duck.

Raptores.—Birds of prey may be divided into *diurnal*, or such as fly by day, and *nocturnal*, or such as seek their prey by night.

The **Diurnal Raptores** comprehend the Falcons and Vultures.

The true **Falcons,** from which this group derives its name, are bold and daring birds; their skeleton is very strong in proportion to its lightness, and their sight is exceedingly acute. The true Falcons were formerly called *noble* birds of prey because they were trained for falconry, which was termed a noble sport, whilst others were called ignoble birds. The birds of prey strike their victims with their talons, which, you will see from the annexed drawing of the foot of a Falcon (Fig. 50), are well adapted for their office. The Peregrine Falcon is noted for the rapidity of its flight. It has been known, according to Dr. Carpenter, to have travelled from Fontainebleau to

Fig. 50.

Raptores.

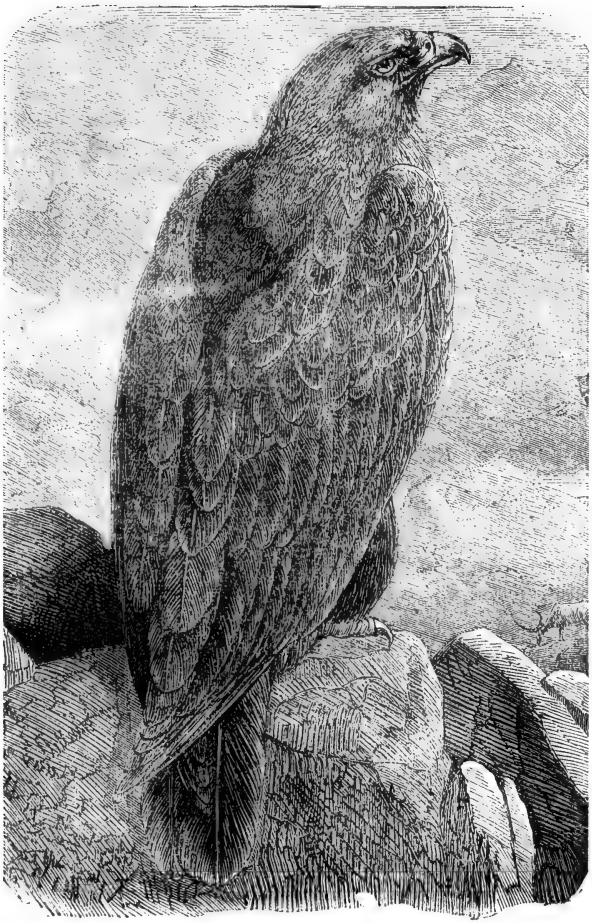


Fig. 51.—THE ROYAL EAGLE.

Malta (not less than 1,350 miles) in twenty-four hours, which, had it been on the wing the whole time, would have been about fifty-six miles per hour; but as falcons do not fly by night, it was probably not more than sixteen or eighteen hours on the wing, and must therefore have flown at the rate of between seventy and eighty miles an hour.

To Falcons also belong **Eagles** and **Hawks.**

The **Eagles** are remarkable for the power and extent of their vision, for their great strength, courage, and noble bearing. They generally attack larger animals—only assailing smaller birds when pressed by hunger, and even then they do not willingly touch any food unless they have killed the animal for themselves.

Eagles build their nests, which are called *eyries*, on the tops of mountains or rocks. They are very strong, so as to resist the force of the wind to which they are exposed in such situations. They use branches of trees and large pieces of wood, which their strong talons and their powerful body enable them to transport to the spot they select.

When rearing their young, eagles collect all the food they can get and bring it home to the eaglets. A man in Antrim having taken a pair of eaglets from an eyrie, placed them in such a manner that their parents could visit them, and during an entire summer they were daily supplied with rabbits, hares, &c., in such quantities that the owner obtained sufficient animal food for himself and his family.

The **Hawks** are in character very like Falcons, and were also used in sports in bygone times. But some of the family—the Kites, or "Gleads" (this name seems to have been derived from "glide," because the bird flies with a gliding motion)—at one time fulfilled a much more useful purpose, for, even as late as the reign of Henry VIII., they were the chief scavengers of London and other towns,

and at the present time they perform the same duties in Turkey and Egypt.

One tribe of falcons is called the **Secretary Bird,** from the plumes which project at the back of the head, and look like the pen behind the ear of persons engaged in writing pursuits.

The Secretary preys principally on serpents and other reptiles, which it kills by a blow of its beak on the head of its enemy. A celebrated traveller, named Le Vaillant, mentions that, having killed one of these birds, he found in its crop eleven rather large lizards, three serpents of an arm's length, and eleven small tortoises, very entire, all of which had been killed by the stroke on the head; there were also a number of locusts, beetles, and other insects, very little injured.

Vultures are totally different in character from the other birds of prey; they are exceedingly cowardly, and never, if they can help it, attack a living animal, but will eat the most filthy and putrid food. They are thus the *scavengers of nature*, and have such a powerful sense of smell, and of sight as well, that they appear as if coming from an opening in the clouds the moment any animal dies. They can even smell if there is a dead body in a house, though they cannot see it, and instantly come and perch on the roof. Vultures have enormous strength in their wings, and this enables them to carry away whole bodies of animals which may lie putrefying. They are highly valued in Egypt and Turkey; and a species of them, called the Turkey Buzzard, is also much prized in Jamaica, owing to the services they render in cleansing the streets from filth of every description. This office is performed in India by a bird of the stork family, called the Pouched Adjutant, which will be referred to further on.

The **Nocturnal Raptores** comprise the **Owls,** which

are distinguished from the other Raptores by the size of their heads, and by their enormous cat-like eyes, which are in some species surrounded by white discs, which serve to gather the scanty light, and convey it to the organ of sight. They are like the cats, too, in their very quiet movements. Their feathers are very loosely placed, the intermediate space being filled up by soft down; this enables them to fly with the utmost quietness, so as to pounce upon any little animal that may be sleeping, or that may be "out late." The greater part of the owls of this country feed on rats and mice, whilst those in the north of Europe seem to feed on birds.

Fig. 52.

Passerines (called also Insessores, or Perchers).—The name of this order is derived from *passer*, a sparrow, and this will at once give you an idea of the kind of birds it contains. They are all such as do not belong to the other definite orders, and amongst them we meet with all those that build the comfortable "nests" for their young, and also all the birds which charm us with their singing, such as the **Nightingale** (Fig. 53), the **Thrush,** the **Warbler,** &c. They have all four toes, which are generally placed three in front and one behind (Fig. 54), and there are none of them which have two toes in front and two behind. As these birds are almost constantly on the wing,

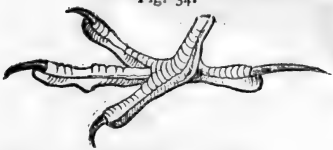
they are furnished with very short and slender legs, whilst their wings are generally very large.

Scansores, or Climbers.—The birds belonging to this order are easily distinguished by their feet, on which the

Fig. 53.

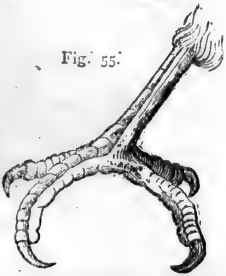
THE NIGHTINGALE.

Fig. 54.



FOOT OF THE LARK.

Fig. 55.



FOOT OF THE WRYNECK.

toes are placed two before, and two behind (Fig. 55); and they are thus enabled to take such a firm hold on the branches of trees that they can turn over and over, as you have no doubt seen parrots do many a time; and in these

gymnastic exercises they are assisted by their curved beaks, which serve as climbing-hooks. To this order belong **Woodpeckers, Wrynecks, Cuckoos, Parrots,** and **Toucans,** with all their relations. Parrots and Cockatoos (Figs. 56, 57), and their funny sayings and

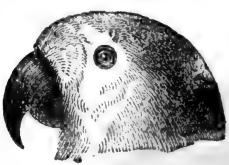


Fig. 56.
THE PARROT.

Fig. 57.
THE COCKATOO.

doings, are too well known to require description. The **Woodpecker,** however (Fig. 58), claims our attention. From the engraving, you will see that his toes are longer and more straight than the parrot's. The fact is, he prefers getting his living by carpenter's work rather than by tumbling; and his whole structure is adapted for this

mode of life. He sits on his widely-spread feet, and his tail—which is composed of ten stiff quills—supports him at the back. His beak is straight and sharp, and he pecks into the bark of trees till he has made a deep hole. Into this he extends his tongue, which is armed with barbs at the end like the teeth of a saw. These turn backwards towards the bird's head; and as the tongue is fixed inside the back of the head, it works by a sort of spring, and so deepens the hole and brings out the insects or their eggs which form the food of this hard-working bird.

Fig. 58.
THE WOODPECKER.

Rasores, or Scratchers, are also called Gallinaceous birds, from *gallus*, a cock; the **Common Fowl** being the specimen by which the whole order may be known.

They are, however, better distinguished by the name of Rasores or scratchers, this being their general occupation; for you must know that they all live principally on corn, but have no teeth with which to masticate the hard coating of the grain. They therefore swallow it; and it passes firstly into a bag called the "crop," to be soaked (this corresponds with the paunch of the ruminants), and, after

passing through another narrower division of the stomach, it reaches the gizzard, which is made of a very tough substance; in this there is a quantity of gravel, &c., which the bird has swallowed, and these little stones serve instead of teeth to grind up the softened food. These birds, like the perchers, have a very strong tendon in their leg, which passes from the toes up to the haunch; and as the weight of the bird bends the knee-

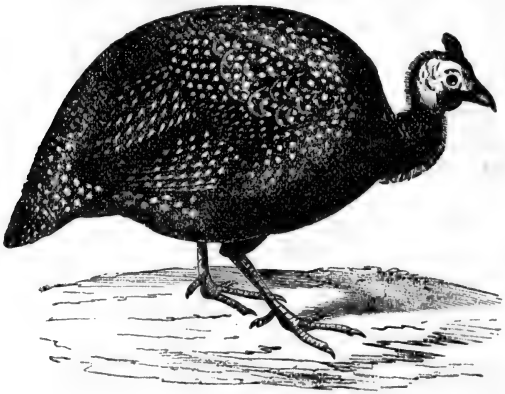


Fig. 59.

THE GUINEA FOWL.

joint, the tendon is drawn up, and the toes clasp the more tightly round their perch; the effect of this is still further increased when the bird rests on one foot only. The principal families of scratchers are the **Turkeys, Peacocks, Guinea fowls** (Fig. 59), **Pheasants, Grouse,** and **Pigeons**—which last are, however, sometimes classed as a separate order.

Cursores, or Runners.*—The birds forming this order

* *Cursor,* a runner; from *curro,* to run.

are distinguished by their strong legs and by the smallness of their wings, which are wholly unfitted for flying, and in some of the species are almost absent altogether. They consist of two families, which are represented by the **Ostrich** and the **Apteryx.**

The **Ostrich** has wings, which, although of no use

Fig. 60.

THE AFRICAN OSTRICH.

for flying, are still of assistance in walking, for they are covered with those beautiful plumes called "ostrich-feathers," which strike against the wind, and serve to propel the bird. The African Ostrich has only two toes, the outer one of which is but half the length of the other. The feet, like those of the Camel, are peculiarly adapted for running on the sandy deserts of Arabia and the interior of Africa; and it is said that this bird is

the fastest runner of all animals. They lay eggs weighing nearly three pounds each.

The **Rhea,** or American Ostrich, is a native of the plains bordering the river La Plata, extending through the south of Brazil to the north of Patagonia. It is rather smaller than the Ostrich, and has three toes on each foot.

The **Emu** is a native of New Holland, and is quite as large as the Ostrich. The wings are scarcely visible at all, and such as they are, they are hidden under the coat of the bird, which can scarcely be said to be formed of feathers, being more like a mass of strong branching hairs.

Fig. 61.

HEAD OF THE CASSOWARY.

The **Cassowary** is a native of Java, and has no wings that can be termed such. Like the Emu, the covering is not like feathers, but resembles the hair from a horse's mane. Two species are known — one of which has a strong bony helmet on its head (Fig. 61), and the other is without this appendage.

The **Apteryx** may be said to be really wingless, for it only has the merest rudiments of wings so buried under its hairy covering that they can only be found with considerable difficulty. This bird is a native of New Zealand, and feeds on worms, which it obtains by thrusting its long beak into the soil. It is supposed that the Apteryx is becoming extinct, like several others, of which skeletons are found

in the earth, but living specimens of which no longer exist.

Grallatores, or Stilt* Birds, are sometimes called "Waders." These birds, as their name implies, are remarkable for their long legs, which enable them to wade

Fig. 62.

THE STORK.

after fish, worms, &c., to a considerable depth, without wetting their plumage. Their tail, too, is short, but the wings are large and strong; and their neck and beak generally correspond with the length of their legs. Amongst these we find **Bustards** (which are nearly allied to the Cursores),

* *Grallæ*, stilts; their legs resembling stilts.

Plovers, Lapwings, Cranes, Herons, Spoonbills, Storks, Snipes, Rails, &c.

The **Stork** is very common on the Continent, and in some countries has been held sacred on account of its services in destroying vermin. In India, one of this family, called the "**Argala,**" or **Pouched Adjutant,** not only devours, but carries off, in a large pouch situated in front of the throat, immense quantities of offal and carrion; and can swallow a leg of mutton, a hare, or a fowl at a mouthful. Sir Everard Home found in the pouch of one of these birds a land-tortoise ten inches long, a putrefied black cat, and various other little matters.

From this bird, and an allied species called the "**Marabou** of Africa," are obtained the exquisitely beautiful plumes called "Marabou feathers."

One species of the Stork family is the **Sacred Ibis,** which was so universally worshipped in Egypt. Some writers have thought that it was held sacred because it destroyed serpents; but the real reason seems to be that it appeared at the season when the Nile was about overflowing its banks, from which Egypt derived its fertility; and the arrival of the Ibis seemed to herald the coming of the blessings of fruitfulness and plenty.

The **Rails** seem to unite the waders with the swimmers, for we find that some of them, such as the **Coot,** can swim and dive; so can the **Moor-hen.**

Amongst the stilt-birds must also be ranked the **Flamingoes.** The legs of these extraordinary birds surpass in length any of the waders, and they are web-footed. The body is very small, and the neck equally long with the legs. The beak is long and bent. The Flamingo lays her eggs on a mound which she raises, and then sits on them as if on horseback.

Natatores, or Swimmers—sometimes called "Palmi-

pedes"*—are birds adapted specially for life in water. Their legs are placed far back on the body, and the toes are united by a membrane called a web, so that the foot becomes a very efficient swimming-paddle. Their plumage is thick, and close to the skin there is a packing of soft

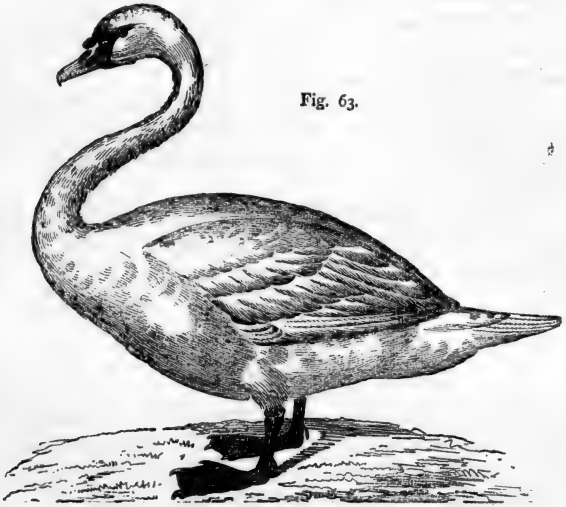


Fig. 63.

THE SWAN.

down; amongst this, oil exudes from the skin, which prevents the water coming into actual contact with their bodies. In some cases the neck is longer than their legs, so that, whilst swimming on the surface of the water, they can reach their prey, which may be near the bottom. This is seen in the **Swan** (Fig. 63).

Amongst the Natatores we meet with some birds, such

* *Palma*, the palm; *pes*, the foot.

as the **Penguin,** whose legs are placed so far behind that the animal moves about in an upright position, the wings being so small that it cannot fly. When in the water, however, these wings are used pretty much like the fins of a fish; and we find others, such as the Albatross, whose wings are of enormous size.

The **Albatross** is one of the largest of aquatic birds. Its wings, when spread out, measure fourteen feet, and it weighs twenty pounds.

The **Frigate** bird, too, has wings of nearly the same extent, and is found playing the tyrant of the sea, and carrying on a life of rapine at a thousand miles from shore.

To this order belong all the birds included in the various families of **Ducks, Divers, Auks, Gulls,** and **Pelicans.**

REPTILES.

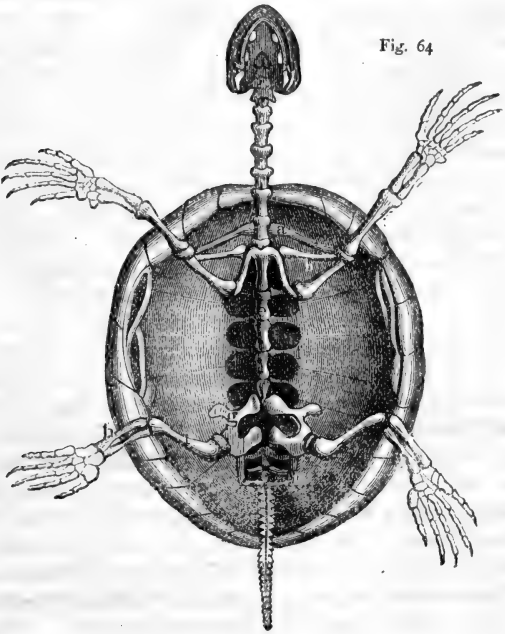
REPTILES are animals which crawl or creep. Some of them have legs, and others have not; but the limbs of such as possess them are not as efficient for walking purposes as in the Mammalia, for they are not placed in an upright manner, but in most cases turn outward from the body, or are short and stunted, so that the animal may be said to shamble rather than walk along. The circulation in reptiles is said to be "incomplete," because in general their heart has but three cavities instead of four, and only a portion of the blood which has been returned from the various parts of the body is sent to the lungs to be purified, but the principal part of it passes again in its impure condition into the system; thus it is not warmed. Reptiles are, therefore, called *cold-blooded* animals, and, having no warmth which requires keeping

in their bodies, they are without fur, hair, or feathers, but are covered either with scales, or are naked altogether.

Reptiles are divided into—**Tortoises, Lizards, Serpents,** and **Amphibia.**

Tortoises are at once distinguished by the double casing in which their body is enveloped; but this is not

Fig. 64



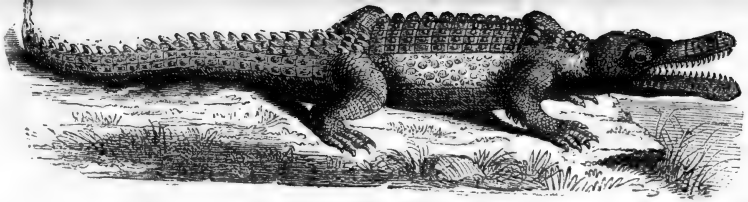
SKELETON OF THE TURTLE.

a "shell." The upper portion, called the "Carapace," is formed by the spreading out of the ribs until they unite with the spinal column, and the underneath part of the case, called the "Plastron," is in reality the breast-bone

extended. From the annexed engraving (Fig. 64) you will see the internal construction of the carapace, and you will observe that the casing is really a portion of the skeleton of the animal. Outside this carapace the flat plates, known to us as **tortoise-shell,** are formed. The true tortoise-shell is obtained from the **Hawk's-bill Turtle,** the principal home of which is in the waters around the island of Ascension. Five large plates are taken from the middle of the back, four from each side, and twenty-five smaller ones from around the rim. These are separated by heating the whole carapace, and passing a broad knife between the bone and the plates. The plates can be softened in boiling water, and may be joined by being pressed between hot irons. There are **Land Tortoises** in which the carapace is very round and high, and which have upright short legs, like pillars cut short, with horny, hoof-like claws. These are not always the little things so often sold about the streets of London, for in the tropics there are some which take six or eight men to lift from the ground, and which yield two hundred pounds of excellent meat. Then there is the **Pond Tortoise,** which has its feet flattened, and its carapace covered with scales; the **River Tortoise,** which has a soft skin over its bony case; and finally we have the **Turtle,** or **Sea Tortoise,** in which the feet are perfectly flattened, so as to become large and strong swimming paddles. The turtle from which delicate meat is obtained, and from which turtle soup is made, is the **Green Turtle,** of which great numbers are imported annually. They are packed one upon the other in casks of sea-water, which is changed daily.

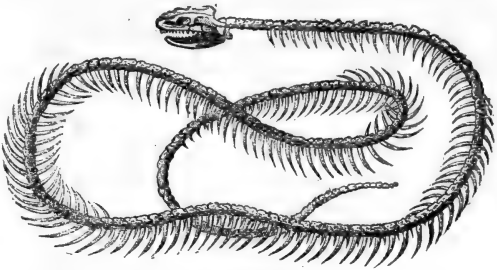
Lizards or Saurians.*—These might almost be called serpents on legs, for all their movements are

* *Saûra,* a lizard.



Saurians.

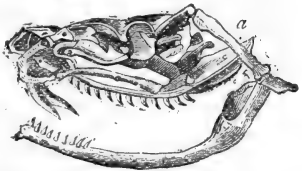
Fig. 65. THE CROCODILE.



Serpents.

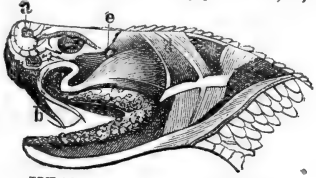
Fig. 66.—SKELETON OF THE RINGED SNAKE.

Fig. 68.



SKULL OF THE RATTLESNAKE
(Showing Supplementary Jaw Bone, *a*.)

Fig. 67.



HEAD OF RATTLESNAKE
(Showing Poison Glands).

serpent-like, and their legs are so very different from the limbs of other animals.

The most "distinguished" member of this group is the **Crocodile** (Fig. 65), which is, indeed, the giant of all reptiles; they are sometimes separated into a distinct class, called "Loricata." They are very ferocious, and although they mostly seize their prey in the water, they retire to land to devour it. Crocodiles have their hind feet more completely webbed than **Alligators.** The former are found in Africa, India, and the hotter parts of America; whilst the Alligator seems confined to America, and is less an inhabitant of water than the Crocodile, but frequents swamps, marshes, &c.

Amongst the lizard family we find the **Chameleons, Geckos, Monitors, Flying Lizards,** and **True Lizards,** and the **Slow Worm** seems to connect them with serpents, but, although perfectly snake-like in outward appearance, still shows in the structure of its skeleton that it is more nearly allied to lizards.

Serpents (Ophidians).*—The animals in this group are such as are wholly devoid of limbs of any sort; the whole skeleton consists, in fact, of only the skull and the vertebræ, with the ribs attached (Fig. 66); and in the **Python,** which is one of the Boa family, the number of vertebral bones reaches 422. These bones work in each other in the following manner:—Each of them has a cavity at one end, and a projecting part at the other, and thus the convex end of the one works in the concave part of the other, in the manner called the ball and socket-joint.

Serpents are divided into five families:—

Water Serpents, some of which live in the sea, and others in rivers. Their food is principally fish, which abound in the inter-tropical waters they inhabit.

* *Ophis,* a serpent; *eidos,* form or shape.

Venomous Serpents, amongst which we find the **Rattlesnake**, the **Cobra,** the **Asp,** the **Viper,** &c. They inflict their deadly bite by means of two large fangs (b, Fig. 67), which are connected with the poison gland. When in a state of quietude, these fangs are bent backward against the roof of the mouth; but when the animal is about striking its prey they are erected, and in this act the muscles (d) which elevate the lower jaw at the same time compress the poison gland (e), forcing the deadly fluid down a channel in the side of the tooth, and it thus at once enters the wound inflicted. Serpents are able to swallow prey which is larger than the size of their mouth might seem to admit of; this is owing to an additional bone, called the *Tympanic bone* (a), the action of which you will understand on referring to the drawing (Fig. 68). By this means the width of the mouth is immensely increased; the animal they have killed is gradually swallowed; and after their meal, the serpents remain for some time in a torpid state. The "rattle" of the Rattlesnake (Fig. 69) consists of a number of horny rings, loosely put together, which rattle against each other with the slightest movement of the animal.

Fig. 69.

The **Boa** family comprises the largest of all serpents, viz., the **Anaconda.** Boas are not venomous; but this is scarcely any advantage to the poor animal which, by adverse fate, has fallen in the way of the giant reptile. It hangs by the end of its tail from a branch of a tree, overhanging some river, and as a quadruped comes to drink it instantly darts down on its prey, coils around it, and literally squeezes the life out of its body—hence its name, boa "constrictor." It then loosens its dreadful embrace, and again gathering around the body, it forces the head down its mouth, extended by means of the

additional jaw-bone already described, and in order that the mass may not slip out during any momentary relaxation of the awful living rope, the teeth are set so that they bend backwards, and thus they prevent the body moving in an opposite direction. Boas have two hook-like claws, sheathed with horn, each terminated by a sort of spur, which seem like rudiments of hind limbs; these assist the animal in moving along.

The **Harmless Snakes** are very numerous. One of them, the common **Ringed Snake** (Fig. 66), is often found in our own country. It lives in low damp meadows, and in the vicinity of water; it feeds principally on frogs, mice, shrews, and small birds, and can swim well. It is easily tamed, and is said to become much attached to the person it lives with. In winter it becomes torpid, having previously taken shelter in some secluded place, where a great number will often collect. Dr. Carpenter mentions an instance within his own knowledge of 1,300 having been found in an old lime-kiln.

The last family of serpents are called the **Double Walkers,** from the circumstance of their moving equally well with either end foremost. They feed on insects and other very small animals, and are natives of the tropical regions.

Amphibious* Reptiles are such as by their peculiar organisation are enabled to live on land or in water; and thus they breathe by means of lungs when on land, and of gills when in water. Some retain their *branchiæ*, or gills, and their lungs at the same time throughout their whole life, whilst others lose them at a particular period. Amongst amphibious reptiles with permanent gills may be mentioned the snake-like **Proteus** (Fig. 70). This animal is something like an eel in shape; its gills are not

* *Amphis*, both; *bios*, to live—living in two elements.

Fig. 70.—THE PROTEUS.

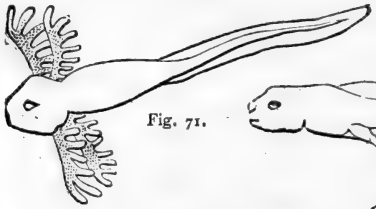


Fig. 71.

Fig. 72.

Batrachia.

Fig. 73.

Fig. 74.

Fig. 75.

Fig. 76.

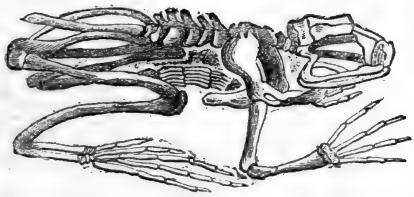


Fig. 77.—SKELETON OF A FROG.

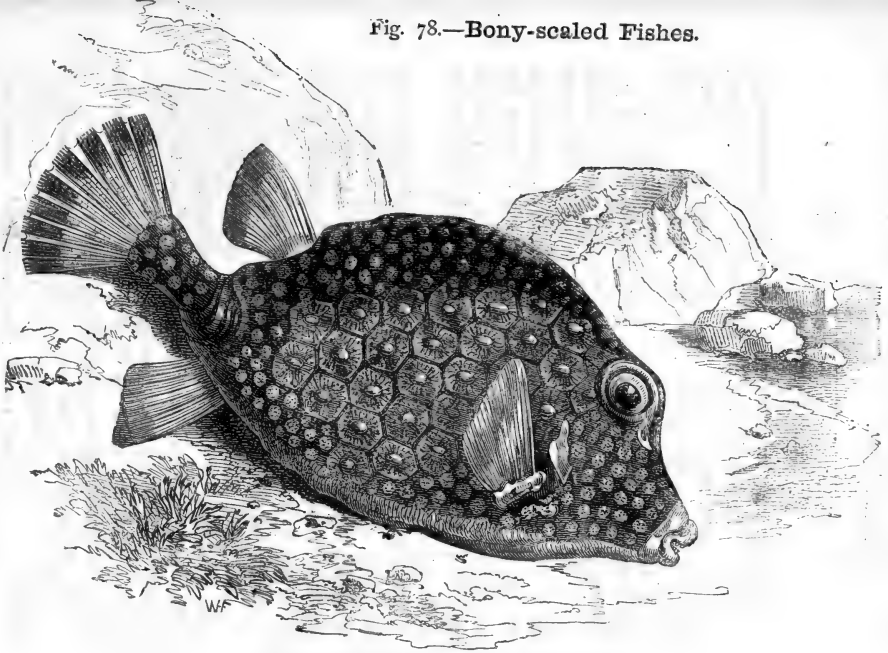
like those of a fish, but hang outside, like a fringe, and, strangely enough, they may be removed and yet the animal remain alive, as it is provided with lungs as well. It has four short limbs, which are very feeble, the front pair having three fingers each, whilst the hinder ones have but two.

A whole family of these amphibious reptiles which lose their gills at a certain period of their lives, is separated from the others, and classed under the name of **Batrachia,** and these comprehend the groups of **Newt, Frog,** and **Toad-like** animals.

When the young of the frog issues from the egg, the gills are only little lumps on each side of the head. These soon branch out, as shown in Fig. 71 ; it then has a long tail, and its gills hang loosely in the water. This figure is drawn larger than it should be in proportion to the others, in order to show the gills plainly. These gills after a while die off, and breathing is performed by another set at the back of the head, the water passing over them through the mouth, as in fishes ; the animal then appears as shown in Fig. 72.

Up to this stage they are called *Tadpoles,* but soon after the hind legs begin to show themselves (Fig. 73), and the lips are covered with a sort of horny beak, which enables it to fix itself on vegetable matter, on which it feeds ; at a later period, the front legs make their appearance (Fig. 74). During the time these changes take place externally, the true lungs are being formed internally, and the gills are no longer used, and disappear ; the horny beak falls off, the animal changes its food, and becomes carnivorous. The little frog cannot now remain long under water, but has to come to the surface to breathe. Gradually the tail becomes shorter, as shown in Fig. 75 ; eventually it disappears altogether, and the animal has reached its perfect form (Fig. 76). The complete skeleton of a

Fig. 78.—**Bony-scaled Fishes.**



THE OSTRACION, OR TRUNK-FISH.

frog is given in Fig. 77; and from this you will observe the small number of bones in the spine, and also the entire absence of ribs.

FISHES.

FISHES are vertebrate animals whose whole construction is adapted for life in water; they have red, cold blood, and are born from eggs. The heart consists of two chambers only. The limbs are replaced by fins, and the body is covered either by bony plates, which form a complete armour, as in the Trunk Fish or Ostracion, of the Red Sea (Fig. 78), in which the plates are so firmly united that a box is formed with openings through which the tails and fins project; or by scales, which in some fishes, as the Salmon (Fig. 83) and the Carp (Fig. 84), are flat and round, whilst in others they are more bony, and of various shapes—some so small and so embedded in the skin as to be scarcely perceptible at all.

The outward form, as well as the internal structure of fishes, is suited to their aquatic life; the body being flattened, generally vertically, but sometimes horizontally; there is no neck, the head, neck, and chest being united in a continuous form.

Fishes breathe by means of gills, of which there are generally four on each side, each composed of double rows of plates. They are fringe-like, membranous plates, fixed on the edge of bony arches, and in these the blood circulates and receives the oxygen which is dissolved in the water which enters at the mouth, and, after bathing the gills, passes out at the opening of the gill-covers.

The Anabas, or Climbing Perch, has a receptacle to contain water for moistening the gills; it can therefore leave the water, and travel along the bank—some say, climb a tree, by aid of spines on its chin, gill-covers, &c.

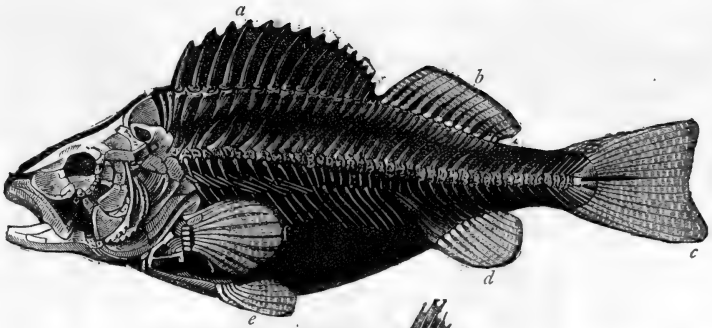


Fig. 79.—THE PERCH.

Bony Fishes

(Spiny Finned).

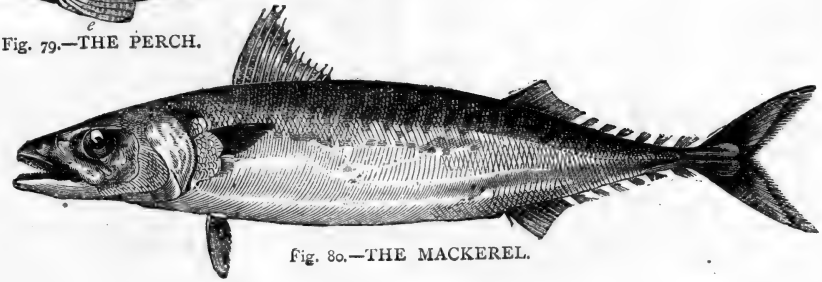


Fig. 80.—THE MACKEREL.

The fins of fishes are named according to their position, which will be seen in the skeleton of a Perch (Fig. 79). here *a* is the first Dorsal fin, and *b* the second, *c* the Caudal, and *d* the Anal fin, *e* the Ventral, and *f* the Pectoral (or chest) fin.

An air-bladder is found in some fishes; its exact use is not quite ascertained, but it is evident that when the ribs are contracted the quantity of air in the bladder is diminished, and the fish becomes heavier; that when the bladder is again full the fish becomes lighter, and its upward course is easier; but fish swimming near the bottom, as the Skate, Sole, &c., have no air-bladder.

The skeleton of fishes is usually bony, but in many cases it is formed of cartilage; and this has led to their being divided into—

Bony and **Cartilaginous.**

Bony fishes are again divided into—

Spiny-finned and **Soft-finned.**

In the former (Fig. 81), the rays are stiff and bony, espe-

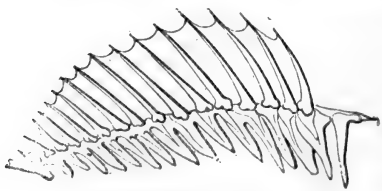


Fig. 81.—SPINY FIN.

Fig. 82.—SOFT FIN.

cially in the dorsal fins; whilst in the latter (Fig. 82) they are soft.

Amongst the spiny-finned fishes, the **Perch,** of which the skeleton is shown in Fig. 79, is a well-known specimen, as it inhabits nearly all the streams and lakes in England, and is found not only throughout Europe, but also in Asia. It feeds on worms, insects, and small fishes,

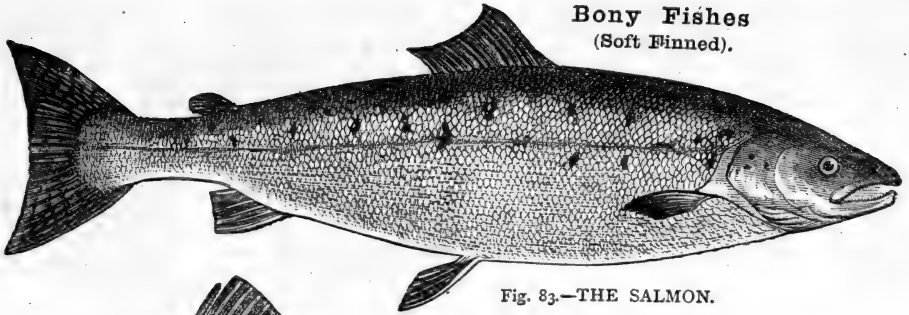


Fig. 83.—THE SALMON.

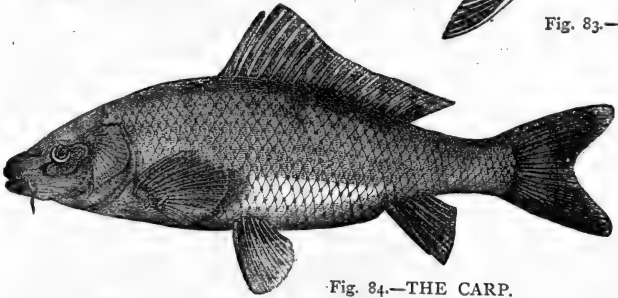


Fig. 84.—THE CARP.

Fig. 85.—THE SPRAT.

which it is quite able to devour, its mouth being very well furnished with teeth. There is also a member of the perch family called the Sea-Perch, which frequents the waters around our southern coast, and is valued as an article of food.

The **Mackerel** (Fig. 80) is another example of the spiny fishes; it is, as you know, a most important fish, as it is much eaten, and is caught in great numbers. It is migratory—that is, it moves about from one part to another, and at certain seasons abounds on the coasts of Europe and America. It is, however, supposed that it is an inhabitant of the deeper waters around England throughout the year, and that its appearance on our coasts is owing to its seeking shore to deposit its spawn; this takes place in May and June, and these months are therefore the best for mackerel fishing.

Soft-finned Fishes:—

The **Salmon** (Fig. 83) is the largest specimen of this group. In the spring it leaves the sea and ascends the rivers in great shoals, swimming with great rapidity, and leaping over obstacles ten or twelve feet high. Salmon deposit their eggs in the gravel, and return to the sea. The young ones, when they are about ten or twelve inches long, proceed to the sea, as their parents did before them. Salmon are caught when they ascend the rivers to spawn, for after this is over they are meagre, and unwholesome for food.

The **Carp** (Fig. 84) is easily reared in quiet ponds; it lives long, and buries itself during the winter months in the mud, abstaining entirely from food.

The pretty little **Sprat** (Fig. 85), the **Pilchard,** the **Sardine, Anchovy,** and the **White-bait** are all members of the **Herring** family. Herrings are, perhaps, the most important to mankind of all species of fish, and the most abundant too; this you will understand when you

are told that the roe of the female herring contains about 68,000 eggs. Great quantities are caught in Holland, but the Scotch herring fisheries are the greatest in the world. No account is kept of the number of herrings yielded by the waters surrounding England, but from the most recent returns it appears that there are 98,000 people employed in the Scottish herring and other fisheries; that the number of herring-boats employed in 1861 was 12,961, representing a value of £296,224; and that the value of the nets used in the same period was £415,057. Of the extent of the pilchard fisheries you can form an idea when you are told that 12,000,000 of these fish have been sold for home use alone in one year, and that the average produce of the Cornish pilchard fisheries is about 60,000,000 of fish.

The principal centre of the herring fishery of England is at Yarmouth, and of pilchards at Land's End.

Sprats abound about the coasts of Norfolk, Suffolk, Essex, and Kent, in November, and some of the following months.

To the Soft-finned fishes belong also the **Pike,** the **Garfish,** the **Electric Silurus,** the **Trout,** the **Cod,** the **Sole,** the **Flying-fish,** &c. This fish does not really fly, but, owing to the expansion of its pectoral fins, it is enabled to leap above the surface of the water. Also the **Remora,** which is remarkable for the possession of a series of cartilaginous plates on the top of its head, by which it can attach itself to rocks, ships, or to other fishes, especially to the Shark.

Cartilaginous Fishes.—In Cartilaginous fishes the skeleton is not so perfect as in Bony fishes, and is formed of cartilage or gristly substance, instead of bone. The skin is sometimes covered with small spikes, made of a substance like that of which the teeth are made, and sometimes they form large sharp-pointed knobs, spread over the whole surface.

To this class belong the monsters of the deep called **Sharks.** The skin of these is covered with very small spines, of a bony hardness, and this, when dried, becomes a sort of natural file or sand-paper, used for polishing ivory, &c. They have not gill covers, but have five slits or openings on each side of their cheeks, through which the water passes. These are, indeed, tyrants of the seas; the most ferocious of them is the White Shark, which has its vast mouth furnished with triangular movable teeth, which increase with age. In the young ones there is but a single row, but in full-grown sharks there are *six*. "They will swallow *anything*," says Professor Rymer Jones, "from a tin can and canvas to fat pork and anchovies." In the stomach of one taken in the harbour at Sydney were found a ham, several legs of mutton, the hind quarter of a pig, the head and forelegs of a bull-dog with a rope around its neck, a quantity of horseflesh, a piece of sacking, and a ship's scraper.

The Greenland Shark does not attack men, but is a great enemy to Whales, which it kills, gorging itself with the flesh and blubber.

Another important member of this group is the **Sturgeon** (Fig. 86). It has strong spines projecting all over its body, and its mouth, which is like a large sucker, is placed under the head, and is without teeth. In front of this, long barbs hang down. It is supposed that as the fish swims along, smaller ones are attracted by these worm-like appendages, and are drawn into the mouth. The tail is, you will observe, larger on one side than on the other. The Sturgeons swim up large rivers, for the purpose of spawning, and sometimes become entangled in fishermen's nets; but they are not often secured, for being so strong, and having such bony spikes, they frequently break away where proper nets are not provided. The author recollects one being caught in the

Fig. 88.—THE EEL,

A BONY FISH, COMPARED WITH THE LAMPREY, ONE OF THE

Cartilaginous Fishes.

Fig 87.

Fig. 86.—THE STURGEON.

Dee, a few miles from Chester; it was about seven feet long. The fishermen brought it in on a truck, in great triumph, and sold it in the market at 6d. a pound; its flesh is very good and wholesome, and is said to taste like veal. These fishes possess very large swimming bladders, which are cut into strips and dried, and the article so manufactured is known to us as *Isinglass*. The roe, too, is very valuable, for it is salted down, and comes into the market as an article of food, much esteemed in Russia, France, and Italy, called *Caviare*. This is made principally from the roes of Sturgeons living in the Caspian and Black Seas. Astrakhan is the principal seat of its manufacture, and about 400,000 pounds weight of it are prepared in a year. The roes are very large. We are told that as many as 1,500,000 eggs have been found in a Sturgeon which weighed 270 pounds; and that in another weighing 2,800 pounds the spawn alone weighed 800 pounds.

Lampreys are also members of the cartilaginous group. In Fig. 87 a drawing of one is given, so that you may compare it with the **Eel** (Fig. 88). The Eel is a bony fish, and has therefore a skeleton, which the Lamprey has not; it has only a long tube of cartilage, without any joints in it. It belongs to the round-mouthed family, which name, you will see by the drawing, it quite deserves. This mouth has, however, a ring of strong teeth; its tongue moves backward and forward like a piston, and so enables it not only to suck up food, but to attach itself to rocks, stones, &c. There are seven openings at the side of the head, through which the water passes. There are Sea-Lampreys, River-Lampreys, and a smaller species, called **Lamperns.**

It is a common thing, in a neighbourhood where the rivers are somewhat shallow, to see numbers of poor boys without shoes or stockings, wading about in the water with a tin can or jug in their one hand, whilst with the

other they raise loose stones, to the under side of which they often find Lamperns attached, and so obtain a cheap meal. You will remember that King Henry I. died from eating too many Lampreys.

To cartilaginous fishes also belong the **Torpedo** or Electric Ray, which has the power of giving such powerful shocks that they benumb the limb which has touched them, and they are hence called the Cramp fish.

ARTICULATED ANIMALS.

ALTHOUGH the name given to this division of the Animal Kingdom really means "jointed," it must not be understood to contain only such animals as have limbs with joints, but rather such as are made up of several *rings* jointed together; these, in some of them, are very soft, as in the common **Earth-worm,** which is an example of the group called **Annelida,*** because it is made up entirely of rings. To this group also belong **Leeches**—which, as you know, are used to draw blood away in certain cases, but which are not used now so much as they were formerly—and also **Sand-worms,** which no doubt many of you have seen on the sea-shore. The Earth-worms are provided with delicate bristles, which assist them in moving, and which are too small to be seen by the naked eye, excepting on very large worms; but Leeches have no such hairs.

Some of the Annelids appear to breathe by the whole surface of their body; but some, as the Sand-worm mentioned above, breathe by means of a series of tufts or fringes along each side of the back, which are really the gills of the animal; and a third division of them live in a tube, from the end of which they hang out a series of beautifully coloured plume-like fringes; by these they

* *Annulus*, a ring.

obtain the air, which is dissolved in the water in which these gills float gracefully.

Myriapoda* are so called from their possessing a very great number of feet—certainly not a myriad, but still enough to have given rise to a name which must be taken to mean *many*-footed. In these animals we find the rings broader and much stiffer than in the bodies of worms; they vary in number, but are never less than twenty-four. They have a distinct head, furnished with eyes, mouth, and feelers; all the other segments of their body are alike. They breathe by means of minute pores, called *spiracles*, placed all along the sides of their bodies, and from these innumerable tubes, called *tracheæ*, convey the air over the entire system. They are divided into **Millepedes**†—which have the greatest number of legs; but these legs are not jointed, but bristle-like, as in worms—and the **Centipedes,**‡—which have fewer legs, but these are jointed like those of insects.

The Millepedes feed on decayed vegetable matter, and are perfectly harmless; the Centipedes are carnivorous, and some of them have a painful and poisonous bite. When the young Myriapods first emerge from the egg, they are quite without legs; but in a few days they cast their skin, and have three pairs. They keep on changing their coat, each time obtaining additional pairs of legs, until they are fully grown-up.

Insects.§—This wonderful class of Articulata—the members of which are so varied in their forms and habits—are so numerous, that it will only be possible in this small book to give the barest description of their leading features. True Insects are formed in three segments—(1) the Head, with the horns or *antennæ*, and the

* Myriad-footed.
† A thousand feet.
‡ A hundred feet.
§ *Insectum*, divided into segments.

organs of sensation ; (2) the Thorax, or chest ; and (3) the Abdomen, or lower part. The Thorax, again, is made up of three portions, to each of which a pair of legs is attached, for insects have invariably six legs, and to these

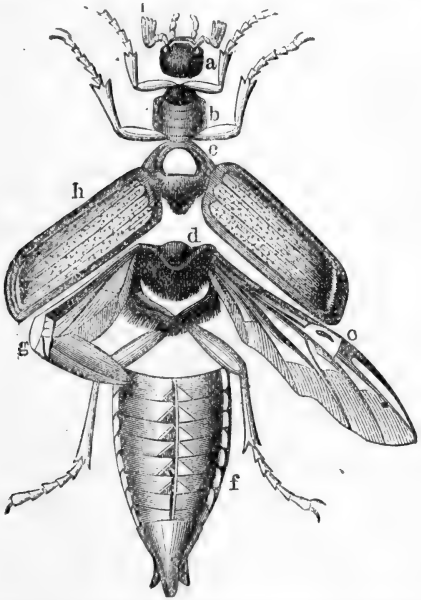


Fig. 89.—**The Segments of an Insect.**

a, the head ; b, c, d, the Three Segments of the Thorax ; e, the Wings ; **f,** the Abdomen ; g, one Wing folded when in repose ; h, Wing-cases ; i, Antennæ (feelers).

are also attached the wings of such as possess them, as most of them do. The division of the body will be best understood by examining the annexed drawing (Fig. 89).

Insects do not breathe through their mouths, but by means of two great tubes (*tracheæ*) running along the

sides of their bodies, which receive air from outside by means of breathing pores (*spiracles*). These air-tubes divide internally into innumerable branches, and thus carry the air into every part of the system. There is a marvellous arrangement in connection with them, which I must not omit to mention to you—namely, the means by which these minute channels are kept open. You must know that each of the tubes is made of two distinct layers of delicate membrane; well, between these a fine thread, finer than you can possibly imagine, is coiled round and round throughout the whole length, just as fine wire is coiled inside india-rubber tubing, to prevent its sides becoming pressed together. By this means, not only is the insect well supplied with air, and thus lightened, but by breathing in every part, its vitality—that is, its powers of life—is increased, so that it is, in proportion to its bulk, the *strongest of living things*. Professor Rymer Jones says, "A common flea or grasshopper will spring two hundred times the length of its body," which is as though a *man could at a single bound leap over the ball and cross* of St. Paul's Cathedral. It has been calculated that in its ordinary flight the common house-fly makes with its wings about six hundred strokes in each second of time, which will carry it about five feet; but this speed can be increased to from thirty to thirty-five feet in a second. Now in this space of time a race-horse could only clear ninety feet, which is at the rate of more than a mile in a minute; so that when you are told that 10,000,000 of the fly would hardly weigh as much as the race-horse, you will see how wonderful is the speed of the comparatively tiny creature.

Fancy if the fly were increased in size until it equalled the race-horse, and its powers of flying increased in equal ratio, how great would be the speed at which it would be able to travel!

But this could never be, for an insect which has attained its complete form ceases to grow. And I must now explain the meaning of "its complete form." You must know, then, that when an insect first comes out of the egg it is quite different from what it is intended at a future time to become. It is at first called a Grub, a Maggot, or a Caterpillar, according to the tribe to which it belongs. Linnæus* called the animal at this stage the **Larva** or mask, because it seems as if the form of the caterpillar was a mask to the complete insect. During this period the animal seems to do nothing but eat, changing its skin several times; and any one who has seen a cabbage garden, when the green caterpillar has taken a fancy to it, and has literally eaten all but the mere stalks; or any boy who has kept silkworms (for these are *caterpillars and not worms*), and has observed the speed with which they dispatch the leaves provided for them, will be quite aware of their appetite. During this period they increase greatly in size, and the caterpillar of the butterfly or moth spins a covering of silk over its body, and, wrapped in a leaf, suspends itself by a single thread; in fact, it sometimes buries itself in the earth. In this stage they are called the **Pupa** or **Chrysalis.** The first name means "a baby," because they look so much like babies tied up in what used to be called "swaddling clothes," in those days when infants were wrapped up thus; and *chrysalis* is a Greek word, referring to the bright or golden colour of some of them. Gnats do not, however, wrap up after this fashion, but pass their infancy in the water; and Crickets and such like are as active as ever.

At the end of the second period the chrysalis throws off its skin and emerges as the **Imago,** or perfect insect,

* Linnæus, Karl von, one of the greatest of naturalists, was born in Sweden in 1707, and died in 1778.

the gorgeously painted butterfly or the busy bee; but this perfect condition does not endure long, for most of them die immediately after they have laid their eggs. The Bees and Ants, however, continue much longer in the complete state.

The liquid which represents the blood of insects is cold, transparent, and nearly colourless; the heart is a long tube running along the back, and is therefore called the dorsal vessel. This fluid is not always contained in vessels, but is diffused between the muscles and other organs.

The eyes of insects are as wonderful as the other portions of their construction, and are of two sorts—simple and compound. Nearly all insects have two compound eyes, but some have the simple ones instead, whilst others have both kinds.

Thus, the bee has three simple eyes, which seem like so many gems set in front of the forehead. Then on each side of the head is a large projecting mass, which, on being examined with a microscope, is found to be made up of thousands of small eyes, each of which is perfect in itself, yet all uniting in one great nerve. Each of these minute eyes has a six-sided face, each has its retina, and each has its separate nerve which unites it with the main nerve.*

The compound eye of an ant has fifty of these separate lenses; that of a common house-fly, four thousand; that of a butterfly, seventeen thousand; and that of the Mordella beetle, *twenty-five thousand.*

The annexed pictures (Figs. 90 to 94) show the metamorphosis of insects—the example chosen being the common Silkworm, or, more properly, the silk-spinner; for you will by this time be quite clear that the caterpillar

* See "Our Bodies," Cassell's Primary Series, p. 101

Metamorphosis of Insects.

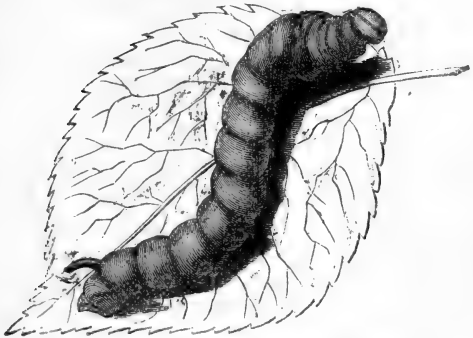


Fig. 90.—**LARVA** OF THE SILKWORM.

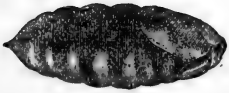


Fig. 91.—**PUPA.**

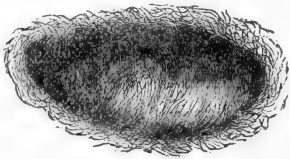


Fig. 92.—**COCOON.**

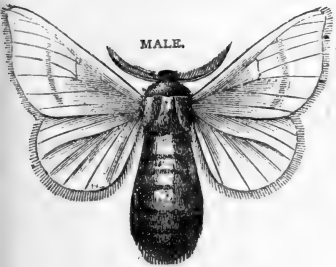


Fig. 93.

Fig. 94.

IMAGO, OR PERFECT INSECT (the Moth of the Silkworm).

is not a *worm*, for a worm is, as you have seen, an annelid, and *does not change*, whilst the caterpillar is only one stage in the life of the moth. The silkworm was introduced into Europe from China in the sixteenth century. The Greek monks brought some of its eggs to Constantinople, and it afterwards spread into Sicily and Italy; but it was not until the reign of Henry IV. that the rearing of the caterpillar and the manufacture of its silk acquired the importance as a branch of industry which it now possesses. This importance to Great Britain alone you will be able to judge, when you are told that 1,600 caterpillars are required to produce a pound of silk, and that we import about 12,814,700 pounds per year, the value of which is £10,000,000; and this is besides about £6,500,000 worth of manufactured silk goods. So that, altogether, the commercial value of the little insect to this country is more than £16,000,000.

The limits of this book will not allow of even a brief description of the numerous groups and families of insects: such account must be reserved for a future volume. I will therefore briefly mention that they are classified principally according to their wings. Thus, we have the *sheath-winged*, such as the **Beetle** family; the *straight-winged*, as the **Cricket, Locust,** &c.; the *nerve-winged*, of which the **Dragon-fly** is a specimen; *membrane-winged*, as the **Bee; *twisted-winged***, as the **Stylops**—a little insect which usually lives on the bodies of other insects, and which has a twisted appendage placed in front of its wings. Then we have the *scale-winged*, or **Butterflies:** for you must know that every particle of the dust which is rubbed off on your fingers when you have touched a butterfly, is not exactly a scale, but more like a feather. You can examine this in your microscope, and you will see that the wing from which the feathers have been rubbed, presents only the beautiful framework which has

served for their support; and thus, even if you release the insect, it is injured, for it cannot fly as well as it could before, any more than a bird could if you were to deprive it of part of its wing-feathers. I am quite sure it is only necessary to point out to you that this is really cruelty to animals, although you might not think it; and I hope you will always remember that however insignificant an animal may be, it has its purpose in creation, and that you are not allowed to injure or persecute it. But to continue: we have next the *half-winged*—so called because their wing-covers are half stiff and leathery, whilst the other half is very thin, as in the **Water-Scorpion.** Then we find insects with only *two wings*—that is, without the wing-cases; and amongst these are **Flies, Gnats,** &c. And lastly we have insects without any *wings at all*, as **Fleas, Spring-tails,** and **Parasites,** which are minute insects that do not undergo any changes, and live entirely on the bodies of other animals.

Arachnida,* or Spider-like animals.—It was for a long time the custom to call Spiders *insects*, but they differ in so many ways that they form a separate class.

Firstly, instead of the bodies being formed of three sections, as in insects, those of arachnidans consist only of *two*, the head and thorax not being separated, but forming together the part called the *Cephalo Thorax*.†

Secondly, they have always *eight* legs.

Thirdly, *they do not undergo any changes.*

Fourthly, *their eyes vary in number and position*, but are never compound.

Some of the lower forms of arachnidans breathe in the same manner as insects; but in **Spiders** and **Scorpions,** which form the principal members of the group, the

* *Arachne*, a spider (Greek).
† *Cephale*, the head; *thorax*, the chest.

respiration takes place by means of air-bags, the sides of which are so folded as to expose as much surface as possible to the action of the air. This arrangement is something between a water and an air-breathing apparatus, for most of these creatures frequent damp situations. These bags open by spiracles on the under side of the body, and can be closed by horny lips.

The Spider family secrete a poisonous fluid, which is fatal to insects, and even to small birds.

Arachnida are divided into three principal groups, viz.:

MITES, SCORPIONS, AND SPIDERS.

Mites (Fig. 95) are very small; in fact, some of them are microscopic members of the group. Some live on leaves; some infest the bodies of insects; and others, as the cheese-mite, live in cheese and other provisions. If you have a microscope, and get from a cheesemonger a little of the dust which has been shaken out of the cracks in rather dry cheese, you will be surprised to see that what seemed to your unassisted eye merely very fine dust, lying perfectly still on a piece of paper, as *dust* would do, becomes, when under the microscope, a mass of life: hundreds and thousands of well-armed animals, such as you will see in the annexed drawing (Fig. 95), ranged in battle array, fighting furiously, and all about some tiny scrap of cheese or some of their empty egg-shells. This will afford you much amusement, and you will admire the wonderful construction of such minute creatures.

Scorpions (Fig. 96) are at once known by their formidable *palpi** or feelers, which are so large that they resemble the pincers of Lobsters and Crabs. They run very quickly, and strike their prey with the hook at the end of their body. This sting has several openings under

* *Palpo*, I touch (Latin).

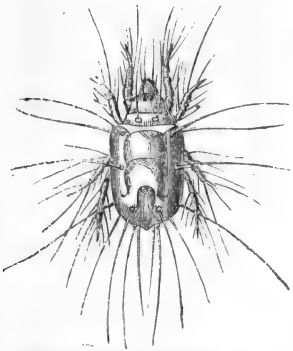


Fig. 95.—THE CHEESE MITE (very highly magnified).

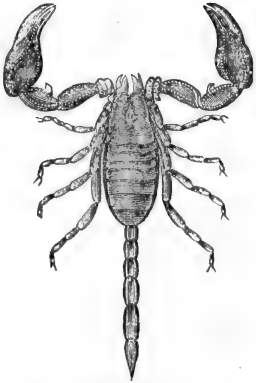


Fig. 96.—THE SCORPION.

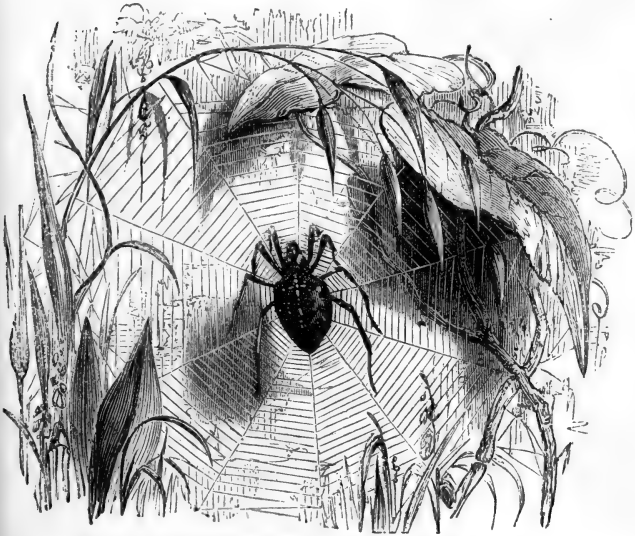


Fig. 98.—THE GEOMETRIC, OR GARDEN SPIDER.

it, and through these the poisonous fluid flows into the wound, and often proves fatal to animals as large as dogs.

The large Scorpions of warm countries are fatal even to man; but the species which inhabit Europe do not appear to be so. Scorpions take up their abode under stones, amongst ruins, in caves, and other damp places; and feed upon Beetles, Woodlice, various ground insects, and on the eggs of Spiders and Insects.

The female is very attentive to her young ones, and carries them on her back until they can shift for themselves.

Spiders.—The Spiders are so well known to you that it is scarcely necessary to describe their general form; but as you may not yet have examined one carefully, I will just tell you something about their *spinnerets* (Fig. 97). These are the mouths of four bags, which receive a sort of fluid silk from a gland inside the body; and through this the wonderfully fine threads of which the Spider spins its web, are drawn. Each of these spinnerets is pierced with innumerable little openings, from each of which the exquisitely fine silk proceeds, all the threads uniting into the one which is perceptible to our eyes. All spiders have spinnerets, but they use their threads for different purposes, according to their habits. Some employ it—as you know the **Geometrical** or **Garden Spider** (Fig. 98) does—for constructing the wonderful web; so does the common house spider, whose web is like a flat piece of very thin gauze fastened up in an angle of the walls. Some weave for themselves habitations in which they live; others make their home in crevices in walls, which they line with their soft, silky

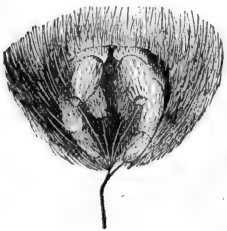


Fig. 97.

matter; whilst the Trap-door Spider of the West Indies burrows deeply into the ground, lines it well with silk, and makes a perfectly circular trap-door to fit the opening, and attached to it by a silken hinge. Almost all spiders wrap up their eggs in a silken cocoon, which some of them tear open when the young are hatched. Some carry these egg-cases under their breast, others at the end of their body; and when the young ones are set free, they swarm over the body of their mother, who carries as many as she can make room for on her back.

Spiders kill their victims by means of their formidable jaws, armed with sharp fangs, through which the poison passes into the wound. The bite of a house-spider is instantly fatal to flies and other insects; and that of some of the larger species is even dreaded by man, being very painful—not only producing much inflammation and swelling, but often much fever. Death has been known to result from it. One large species, called the **"Bird-Spider,"** whose body is more than an inch and a half in length, and which has its home in the Brazils, but which is also met with in great numbers in the Plains of Santarem, devours birds, lizards, &c.

There are very numerous families of spiders, and they have been arranged, according to their habits, into five groups:—1, Hunting Spiders; 2, Wandering Spiders; 3, Prowling Spiders; 4, Sedentary Spiders; 5, Water Spiders.

The last order of Articulated animals is that called—

Crustacea, which seems to represent insects and spiders adapted for life in water. The skins of these animals, however, instead of being merely a stiff membrane, gather horny or calcareous* matter from the waters in which they live, and so form a crust around them, which

* *Calx*, lime.

becomes so much a portion of their body that it has been called an *outer skeleton*. These animals, like insects, are formed in segments, sometimes twenty-one in number, of which seven belong to the head, seven to the thorax, and seven to the abdomen. But these are generally united into masses. Thus, in the Lobster (Fig. 99), the head and thorax are joined together, but the divisions can be traced in the under side; whilst in the Crab, the segments are still further united, and form the large shell which, you know, completely covers the thorax of the animal (Fig. 2).

Some of the Crustaceans breathe by means of gills, which are somewhat in the form of plates. In the lower tribes of the class they project from the surface of the body; but in the higher, they are contained in a cavity through which water passes. Almost all of these animals live in water; but some—known as **Land Crabs**—can leave it for a time. These are provided with a kind of spongy structure in the chamber containing the gills, by means of which they are kept moist.

The hard coating or shell of Crustaceans is shed at regular periods; and they are enabled to renew it by means of little lumps of limy matter contained in their stomachs, known as "crabs' eyes." Directly the old shell is shed, the lime mixes with the blood, and makes its way to the surface of the skin, and so forms the new shell. Of course the stock of lime is thus exhausted; but the crabs' eyes are formed in the stomach again by the next time the animal requires a new covering.

We find in Crustacea both simple and compound eyes, as in insects. In some they are immovable; but in others, such as the Lobster, they are placed at the end of a stalk, which can be projected from the orbit, and thus enable the animal to see in all directions. These animals are therefore termed *stalk-eyed*. In some, these footstalks are short; but in others—as in the Sentinel Crab, of the

Fig. 99.—**Crustacea.—The Lobster.**

Indian Ocean—they can be extended to a considerable length.

Most of the Crustacea present quite a different form when they first issue from the egg from that which they afterwards assume. A tiny creature, which had been drawn in a Dutch Natural History in 1778, and which was there described under the name of the "Zoea," was supposed, until 1822, to be a complete crustaceous animal. Several more of them were met with in the Atlantic, and at last Mr. T. V. Thomson met with hundreds of them in the Cove of Cork; and they turned out to be nothing more than *common crabs in their larval condition.*

I must refer you to the annexed engraving (Fig. 99), in which you will see that the Lobster has four feelers (*antennæ*) attached to the head, and that it has *five* pairs of jointed limbs, not intended for walking, but for seizing prey and conveying it to the mouth; and they are therefore called "foot-jaws." Next follow two enormous limbs, each ending in a strong pair of pincers. One of these limbs has knobs or lumps projecting from its edge; and this one the lobster uses as an anchor, and holds on by it to some stone or branch under the water. The other limb has saw-like teeth on its edge, and with this the animal seizes and tears up its food. Then follow four pairs of very slender legs, which would not be of much service for walking purposes on land; but the lobster does not walk much—and when it does, the water under the body supports it, and the animal moves along in a manner which looks so very awkward and unbusiness-like, that one does not wonder that all of a sudden it gives up its walk and takes to swimming. And then, by the action of its broad, fan-like tail, it can clear a distance backward of twenty or thirty feet. When it uses its tail for a stroke downwards, the fan expands; and when it raises it again for another, it closes, so as to offer as little resistance to the water as possible.

Under the tail there are some still more feeble limbs called the false feet, which are used for fixing the eggs which the female lobster attaches to them.

To Crustacea belong all the various kinds of **Crabs, Lobsters, Prawns, Shrimps, Sandhoppers, Water-Fleas,** &c. &c.; also **Barnacles** (Fig. 100), and **Acornshells.** You have, no doubt, seen Barnacles attached by long leathery stalks to the timbers of piers, but these animals were not always so fixed; in their early life they floated gaily along in the water, and after undergoing several changes they have lost their travelling habits. But you will, no doubt, wish to know how they obtain their food: well, every now and then the shell opens, beautiful feather-like arms spread forth, and entangle the minute animals, or other morsels of food which may come in the way of this living net, and draw them into the mouth, where they are crushed by the jaws. These arms, which curl round in beautiful forms, are called *cirri*, and the animals are thus classed under the name of Cirripeda.*

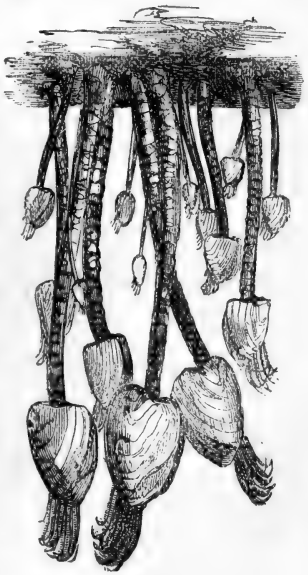


Fig. 100.
BARNACLES.

* From *cirrus*, a lock of hair; and *pes*, a foot.

Another remarkable group of animals belonging to the crustaceans are those called **Rotifera,** or wheel-bearers. These are *Infusoria*—that is, tiny animals which are infused in water, and are so small that they can only be seen by the aid of a microscope. The wheel-bearers are, however, *giants* when compared with others amongst which they live, for they are from one-fiftieth to one-hundredth of an inch in size! When examined, it appears as if a wheel were rapidly turning round, but this is not so: the apparent revolving of the wheel is caused by the bending and unbending of a fringe, consisting of

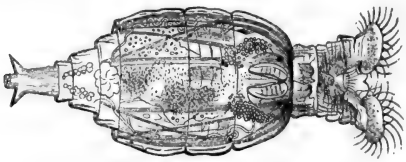


Fig. 101.
ROTIFER, OR WHEEL-BEARING ANIMAL.

a number of exceedingly delicate hairs called *cilia.* By this motion a current is produced in the water, which thus conveys the required food into the open mouth of the tiny creature. Fig. 101 shows a rotifer very highly magnified.

MOLLUSCA.

THE **Mollusca** are soft-bodied animals, having neither internal nor external skeletons. Some are merely covered with a moist slimy skin, whilst others form a shell; but this shell is not any portion of the structure of the animal, as it is in the Articulata, for we find that even in animals which in other respects are almost precisely alike, some,

as the **Snail,** have shells, whilst the **Slug** is left totally unprotected. Nor does the casing assist in motion, for when the animal moves it is compelled to protrude its organs of motion from the shell. The Mollusca are very numerous—in fact, they are almost universally distributed; for some live in water, some on land, and some are

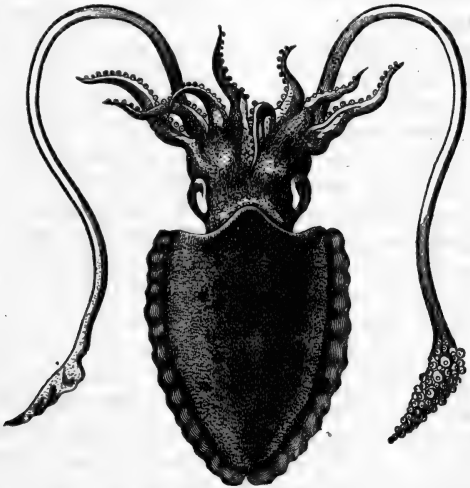


Fig. 102.—THE CUTTLE-FISH.

amphibious. They are, as you may well suppose, very various in their forms and modes of life. I will endeavour to point out the peculiarities of the leading species, as far as the limits of this little book will allow. Firstly, then, I will mention those called **Cephalopoda,** or *head-footed.* You will see that no better name than this could have been chosen, for the *feet of the animal are placed round its head.* These feet are called *tentacles,* and are very strong members; they are covered with

suckers, by which it fixes itself to its prey, or to a rock, or it can swim with them, or walk on them with its head downwards. The specimen here engraved (Fig. 102) is the **Cuttle-fish,** which, although it has no shell, but is contained in a skin, carries inside a hard mass, called "cuttle-bone;" this however, is not *bone,* but seems like a portion of an internal shell. You can easily obtain one at a druggist's shop, and examine it for yourself, and you will find it useful too, for it is a natural ink-eraser, and serves to clean the edges of your drawings, &c. These animals possess an internal bag containing a dark fluid, which, when irritated or pursued, they empty into the water, so as to be entirely hidden from its enemies. They are caught in numbers on the coast of the Mediterranean, and the bag extracted; the inky fluid, after undergoing preparation, becomes the valuable colour known as *Sepia.* According to Professor Forbes, "these mollusks still constitute, as in ancient times, a valuable part of the food of the poor, by whom they are mostly used. One of the most striking spectacles at night on the coast of the Ægean, is to see the numerous torches glancing along the shores, and reflected by the still and clear sea, borne by poor fishermen, paddling as silently as possible over the rocky shallows in search of Cuttle-fish." These animals not only escape by very rapid swimming, or rather darting through the waters, but elude observation by a chameleon-like power of changing colour. The **Paper-Nautilus** and the **Pearly-Nautilus,** which inhabit such beautiful many-chambered shells, belong to the Cephalopoda.

The second group of the Mollusca is called **Pteropoda,*** or wing-footed; these are but small animals, contained in a very thin and delicate shell. The wing-

* *Pteron,* a wing; *pous,* a foot.

foot is an organ made up of bands of muscles, which pass from the neck of the animal, and, protruding from the shell, spread out into two wing-like membranes, acting as a double paddle, by means of which the Pteropoda swim rapidly through the water. Although there are not many species of these animals, they exist in immense numbers, *and form the chief food of the Whale.*

Gasteropoda* are a much more extensive class; so numerous are they, in fact, that they have been further divided into many sub-classes. The limits of this book will not, however, admit of a detailed account of each of these, and we must therefore, for the present, be content with a general description.

The name *stomach-footed* is given to the animals in this class because they walk, or rather trail along, on a fleshy mass or foot, on which their body rests. They are but very slow in their movements, and therefore when any person is inactive or lazy, he is said to be "sluggish," or to "move at a snail's pace." The mantle or skin of the back of some of them is naked and clammy, whilst in others it has the power of forming a shell, called *univalve*, as it consists of *one* shell only. To this group belong **Snails** (Fig. 3), **Slugs, Whelks, Wentletraps, Periwinkles, Cowries, Murexes,** &c.

If you place a Garden-Snail on a piece of glass, it will soon begin to crawl; and if you then raise the glass and look at the under surface of it, you will see the action of the foot when in motion.

Brachiopoda, or *Arm-footed* Mollusca, form a small group; they are contained in a *pair* of shells, which are therefore called *bivalve* shells. Their general form is something like that of the Cockle, but one of the shells is larger and deeper than the other. Their shells are

* *Gaster*, the belly; *pous*, a foot.

generally attached to the rocks in, or at the side of, the water, and they seize their prey by means of two arms, which they can protrude to a considerable distance from their shell, and can draw them in again at pleasure.

Conchifera* are molluscous animals, which are entirely encased in bivalve shells; they have no apparent head, and are therefore called "acephalous," or headless. These animals are most important, as they furnish not only an immense quantity of food, but also supply the valuable

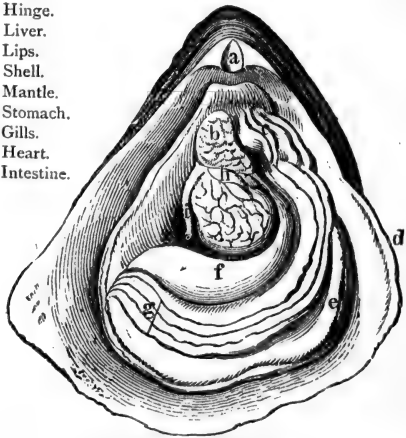


Fig. 103.—THE OYSTER.

articles known as **Pearls.** These are found in the mantles of several shell-fish, but principally in those of the **Pearl-Oyster.** It is scarcely necessary to describe the **Common edible Oyster:** an engraving (Fig. 103) is annexed, from which you will see the position of the various organs. We receive the finest **Pearls** and the shells of the pearl-oyster, which is called "mother of pearl," from the

* *Concha*, a shell; *fero*, I carry.

island of Ceylon. The peculiar lustre of pearls is caused by a substance called *nacre*, which they receive from the mantles in which they are formed. Their gills are in the form of plates, and hence they are called *Lamellibranchiata.* Mussels are well known to everybody. When young, they can move about by means of a foot; but later in their life, a long and strong *byssus*, or beard, grows, and by means of this they attach themselves to rocks or stones. This beard in the **Pinna** is very long and silky. The inhabitants of Sicily and Calabria gather them, and make of the beard a very fine sort of cloth, which is wonderfully soft, warm, and strong; but the animal is now scarce, and hence the manufacture of the cloth is one more of curiosity than of trade.

Clams are bivalves of enormous size; they are, in fact, the largest known conchiferous mollusks. There is a pair of the shells in the church of St. Sulpice in Paris, which weigh more than five hundred pounds; and as the animal is commonly eaten in the localities in which it is found (the shores of the East Indian and Australian seas), you can imagine the quantity of food it supplies. In these the beard is so strong that it is necessary to chop it with a hatchet before the animal can be removed.

Cockles form another group of bivalves. You all know these, and have perhaps seen the poor men, women, and children picking them out of the sand on the shore just after the tide has gone out. The foot is so large, that the animal uses it for boring in the sand, and, taking a firm hold, it draws its body down; by expanding this member, it can jerk itself up again, and move about by springs, much faster than you would think possible.

Razor Shells.—The animal inhabiting these is eaten too; it burrows deeply into the sand, but is caught by dropping salt down the opening, which causes it to come up at once.

Another group of Conchifera are the **Stoneborers,** which excavate deep holes for themselves; some of them work in limestone, others exercise their industry on clay or wood.

The **Ship-Worm** (Fig. 104), however, restricts itself to wood, and bores in every direction; nor is it particular as

Fig. 104.
THE SHIP-WORM.

to the peculiar wood it attacks, for it can bore equally well in the hardest oak as in common fir.

Tunicata.—These form another group of headless Mollusca; they receive their name from the circumstance of their mantle forming not a shell, but a leathery coat or tunic, which the animal inhabits. Some of them live alone, whilst others are associated in compound masses, but without any connection with each other. In another group, such as the **Social Ascidians,** all the individuals are connected by a sort of stem. Finally, the lowest group of the mollusca is that called **Polyzoa.*** Almost every one who has been at the sea-side will have met with some of these in the form of the **Flustra,** or **Sea-mat,** which consists entirely of masses of cells of a horny texture; and if this is examined by means of a strong microscope, each cell will be seen to be inhabited by a minute animal having long tentacles, with cilia (fine hairs), all working away most vigorously to produce a current in the water so as to bring food to its hungry mouth. The following extract from Dr. Carpenter's description of these animals will, I am sure, interest

* *Poly,* many; *zoa,* animals. The entire colony or assembly is termed the "Polyzoary."

you :—"The animals forming these compound structures are usually packed closely together, and are of very minute size, so that a single polyzoary of very moderate dimensions must contain an enormous number of individuals. Dr. Grant has reckoned that in an ordinary specimen of the *Flustra Carbasea* there are about ten square inches of surface; in each square inch there may be 1,800 cells, thus making together 18,000 within this small space. Each of these animals has twenty-two tentacles, so that there will be about 396,000 of these minute arms upon this little specimen. If each of these tentacles has only 100 cilia (and there are probably many more) the whole polyzoary will have 39,600,000 of these minute but important organs."

So that you see it is scarcely right for us to call these "lower animals," or deem them insignificant, when so much creative power has been displayed in their construction. Must we not see in this, as in all the works of nature, the bounteous hand of the Father of All, who has with such infinite wisdom formed the most minute as well as the largest creatures?

RADIATA.

THIS name was, until recently, given to all such animals as had not been classified under the groups hitherto described; but further research has shown that great numbers of the animals formerly called Radiata cannot in reality be so classed. Various naturalists have given their own views as to the division of this group. I adopt here the simplest, in the hope that when you have thoroughly mastered this, you may study the subject further in larger books.

Radiata are those animals whose general structure *radiates* from a centre—that is, spreads out in a rayed or star-like form. This arrangement is very plainly seen in

the well-known **Star-fish** (Fig. 4), which belongs to the class **Echinodermata,*** or spiny-skinned. But this radiating character is not so visible in the outward form of the **Echinus** or Sea-urchin, which is represented in Fig. 105. When the shell is sawn across, however, the whole

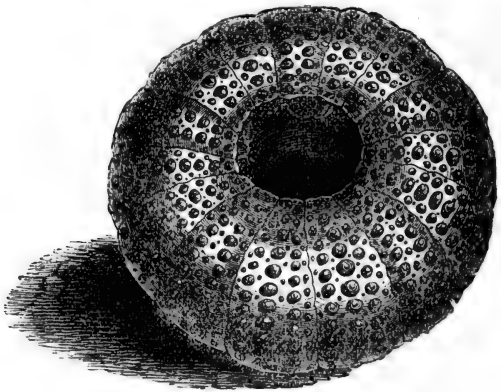


Fig. 105.—SHELL OF THE ECHINUS, OR SEA-URCHIN.

internal structure of the animal is seen to diverge from the centre. You will remember that an orange presents externally an almost spherical form, but when you cut it across you find that all the parts radiate from one point.

The Echinus moves in a most wonderful manner. You will observe that its shell is studded with round, knob-like projections; on these a number of sharp and strong spines, something like those of a hedgehog, are placed, these having a cup-like hollow at their base, so that they work as it were by a ball-and-socket joint; and by these means the Echinus can not only move along, but can bury itself in the sand.

* *Echinos*, a hedgehog; *derma*, skin.

In addition to these, the animal is furnished with long suckers, which pass through rows of small holes in the shell; and by the aid of these it can even climb rocks in search of the small shell-fish on which it lives.

The radiated form is also seen in the star at the head

Fig. 106.—MEDUSA.

of the **Sea Cucumber,** and also in the **Ecrinites** or Lily-formed animals.

We next come to the **Acalephæ*** or Sea-Nettles, which, as you no doubt know, are quite soft, and have received their name from their power of stinging. The annexed drawing (Fig. 106) represents one of this tribe, when

* *Akalephe,* a nettle (Greek).

in the water. These animals are sometimes called **"Medusæ,"** as it is supposed their stinging appendages are like the snakes on the head of Medusa,* and they are also termed Jelly-fishes.

The class **Polypifera,** or **Coral-forming** animals, represents those generally known as **Zoophytes,**† and which are also termed **Anthozoa.**‡ The class seems to be connected with the last-mentioned by the **Hydrozoa,** or Hydroid Zoophytes. The little animal representing this class, the **Fresh-water Hydra** (Fig. 107), has been described in "Our Bodies," in relation to its simple mode of digestion, consisting as it does of a mere tube, around the end of which a series of thread-like tentacles are arrayed; and fixing itself to a twig, or straw, or leaf, by means of its sucker, it throws these out, as a Brazilian horseman throws out his lasso. Not only may the animal be turned inside out without injuring its digestive powers, *but it may be cut into any number of pieces, and each will become a perfect Hydra.*§ One of this tribe is called the **Campanularia,**‖ and consists of a number of branches like those of a plant,

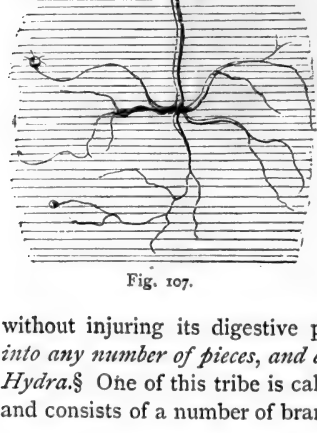


Fig. 107.

* *Medusa,* in mythology, a beautiful female, whose flowing hair was changed into snakes by Minerva.

† *Zoon,* an animal; *phyton,* a plant.

‡ *Anthos,* a flower; *zoon,* an animal.

§ *Hydra,* a monster mentioned in fabled story, which had the power of forming new heads as fast as others were cut off.

‖ *Campanula,* a little bell.

each ending in a star-like fringe, the whole growing in a horny covering, with a kind of bell-shaped cup at the end of each branch.

In the Anthozoa we find, firstly, the **Sea Anemone,** which is a solitary animal, possessing the power of moving from place to place by means of its arms, which spread out in a radiating form, and being beautifully coloured, present the appearance of a bright flower.

Fig. 108.
MADREPORE.

We now reach animals which gather and deposit stony matter. The **Caryophyllea,** and others of the coral-forming family, are, like the Sea Anemone, separate animals, and form their *polypidom** in radiating plates, which you will understand from the annexed engraving (Fig. 108). These plates form partitions of the cells, in each of which a little animal lives. These **Madrepores** are called *lamelliform* (from *lamella*, a thin plate), and are very various in their forms, some branching out like trees, and others taking a more solid form, as in the madre-

* The animals of this group are called Polypes, because they have arms which they spread out something like the tentacles of the cuttle-fish, the ancient name of which was Polyp. The structure they form is called their polypidom, from the Latin words *polypus*, a polyp, and *domus*, a house. The whole class is known as polypifera, from *polypus*, a polyp; *fero*, I bear.

pore, called the "**Brainstone,**" which you have no doubt seen, and which is so called from its resemblance to the human brain. The whole structure of the madrepores is covered with a kind of fleshy matter, which is connected with the animals in the cells; the animals, in fact, seem to be formed by it, for if a piece of this flesh be torn off and thrown into sea-water, it will at once begin to deposit calcareous matter, and form a cell, which will soon be inhabited by a polype. It is to the animals of this group that the formation of the coral islands and coral reefs is due. As the mass rises, mud, sea-weeds, and other matters are deposited upon it by the ocean, and thus a soil is formed, in which the seeds brought by birds take root. Vegetation soon covers the surface thus formed. Groves of trees in time wave their leafy branches in the wind, and at length, attracting the attention of man, the island formed by such humble agency becomes inhabited.

The **Asteroids** form the second order of coral-forming animals. Some of these form a soft and spongy polypidom, whilst in others the dwelling consists of horny or even calcareous matter. They differ from the Sea Anemone in the circumstance of their not existing as separate individuals, being all connected by a fleshy envelope. The Asteroids take varied and beautiful forms, some spreading out in the shape of star-like flowers—hence the name of the group.* Some spread out into long projections, and are hence called "**Dead men's fingers;**" others, which are very large, and cup-like in form, are called **Neptune's cups;** another spreads out in rays like a large plume, and is called the "**Sea-pen,**" which is covered with a flesh-like substance, is fringed on one side of each barb of the feather with numerous polypes, and when disturbed it gives out a bright light.

* *Aster*, a star; *eidos*, form

The well-known **Coral** (Fig. 109) is the type of the next group. The animals which form this beautiful substance do not live *in* the polypidom, but in the fleshy matter which covers it, and of which they form a part—the hard, tree-like stem being formed *inside* this living covering.

Fig. 109.—RED CORAL.

Dr. Lankester, in one of his published lectures, gives the following particulars in relation to coral:—"The Red Coral is found abundantly in the Mediterranean, in the Persian Gulf, and in the Red Sea, and also off the island of Ceylon. In the Straits of Messina there is a coral ground of about six miles, from whence there is obtained about twelve quintals of coral annually (a quintal is about 250 lbs.), so that this district furnishes about 3,000 lbs. of

coral every year. The coral is also obtained in the bays around the islands of Corsica and Sardinia. The French have a coral fishery off the coast of Algiers, which is now a profitable business. As long ago as 1833 there were from 100 to 150 boats employed in this fishery, and the annual value of the coral was estimated at £86,000. Coral has been brought lately in large quantities from the coasts of Hindostan, and it has been recently dredged in the southern province of Ceylon. The method of taking coral from the bottom of the sea is peculiar, but is the same in most localities. The season for coral-dredging in the Mediterranean is from April to July. The dredging is carried on by means of boats. Each boat has a crew of six men, with a caster, who throws out the dredge, and generally directs the proceedings

"The dredge or apparatus employed is a kind of drag-net, and is composed of two beams, tied across with a weight to sink them. Nets are then attached to the beams in such a way that when they are sunk to the bottom of the sea they entangle the branches of the coral, which are then torn from the rocks by the rowers moving the boat with all their force. Several boats' crews are often obliged to join, in order to carry the dredge through the forest of coral in which it gets entangled."

The last family of the Corals consists of animals called **Tubipora**,* or **Organ-pipe Coral.** The fleshy matter which surrounds each polype deposits the stony particles on its outer surface, thus forming a hard ring; as this increases upward, a tube is formed, on the top of which the animal is situated. Numbers of these tubes, each the work of a single polype, are reared parallel to each other, which at regular distances are united by horizontal plates of the stony matter, and the whole structure thus has the

* *Tubus*, a tube; *porus*, a pore.

appearance of pillars supporting several floors of a building.

Protozoa, or First Animals.—Not a drop of water can be left stagnant for even an hour without becoming at once densely peopled with crowds of animals, which are so very minute that but very few of them can be seen by the naked eye; in fact, it is scarcely likely that you would believe all that I could tell you about them, unless you were to use a microscope, so as to examine them for yourself. These minute creatures are called *Infusoria* or *Animalcules*. Their bodies are various in form, and are very numerous. Most of them move freely through the water by means of their cilia; some, however, become fixed, and then the cilia, by their motion, produce a current, which brings particles of food to the mouth; for I must point out to you that the infusoria possess mouths, for this fact will distinguish them from others which I shall speak of presently. One of these animals, called the **Vorticella,** is attached to duckweed, or the stalks of other vegetable structures in ponds and pools, by a long hair-like stalk, which it can extend or contract. Another, called the **Stentor,** is in shape like a trumpet, and is fixed by its narrow end, whilst its wide mouth is surrounded by cilia. Fig. 110 shows a **Flask Animalcula** (Enchelys), from which you will see its modes of feeding. The minute particles having been drawn into the mouth, are gradually swallowed, and each fresh morsel pushes the former one farther down. As many of these particles are seen at once through the transparent substance of which they are composed, the animals were at one time called

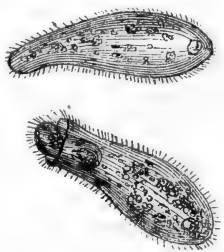


Fig. 110.

polygastrica, or many-stomachs; but what were taken for numerous stomachs have now, by the aid of our improved microscopes, been shown to be merely the particles of food above alluded to, embedded in the soft substance of the body. The smallest known animalcula is the **Monad,** which seems like the merest speck of gum moving freely in the water (Fig. 111). The immense number of Infusoria is caused by their rapid increase; sometimes buds grow out of their sides (as in the Hydra already mentioned), at others numerous ova or eggs are given out; but the most frequent way is by division. Thus, in the drawing (Fig. 111) you will observe that the lowest Monad has become something like the figure 8; the narrow part grows smaller and smaller still, until at length the parts are separated, and become two animals, as seen at *a*. One of the Infusoria, called the **Paramecium,** has been observed to divide itself every twenty-four hours, and each one of the parts to divide again and again; so that in a fortnight, allowing for the same rate of increase, 16,384 animalcules will have been produced, and in four weeks we should have 268,435,456 from the same stock.

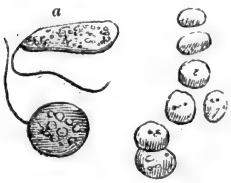


Fig. 111.
THE INCREASE OF A MONAD.

The second division of the Protozoa is that called **Rhizopoda.*** These animals possess no absolute form; hence the best known of them is called the "**Amœba† diffluens**" (Fig. 112). This animal consists of, as it were, the merest speck of gum-water, which moves by throwing out arms or feet from any part of its body, and again contracting them; but this little speck of jelly has its

* *Rhiza*, a root; *pous, podos*, a foot. † *Amoiba*, change.

necessities—it must have food, but has neither mouth nor stomach. Of course, these deficiencies render eating and digesting rather difficult acts, but the tiny creature is still able to get its living, for, pressing its soft substance against the tiny particle it desires to eat, it closes its body around it. It sometimes seems to swallow (if indeed this can be called *swallowing*) some of the minute creatures inhabiting shells, and these coverings, or any other indigestible substances, are got rid of by pressing them out through any part of the body.

Some of these creatures associate in colonies, and form delicate and exquisitely beautiful calcareous shells, each

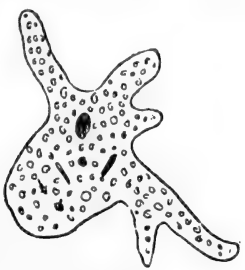


Fig. 112.

divided into chambers corresponding with the number of animals residing in it, pierced with an infinite number of tiny holes, through which they send out their false feet (or *pseudopodia*),* and these have been distinguished by the name *Foramenifera*.† These animals have existed in such incalculable numbers that an important portion of the crust of the earth—viz., the Chalk formation—is mainly formed of them. Whole mountain ranges in southern Europe are formed almost entirely by the fossil shells of

* *Pseudes*, false; *pous*, a foot. † *Foramen*, an orifice; *fero*, I carry.

the **Nummulite**, the largest animal of this group; as is also the stone taken from the Mokkadam range, of which the great Egyptian Sphinx and the Pyramids are built. The beautiful white limestone, of which so great a portion of the buildings of Paris consist, and which is quarried in the vicinity, owes its formation to the **Milliola**, the shell of which is no larger than a millet seed. But even these are not by any means the smallest forms of animal life, for, according to Ehrenberg,* there are above a million shells of Foramenifera in every cubic inch of the chalk of southern Europe, and far above *ten millions in every pound of chalk.* It is from myriads of these minute animals floating in the waters that the luminous appearance of the sea is owing in the summer nights, for the whole crowd emit phosphorescent rays, which make the crested waves beam with light.

Another group of animals, which seem precisely the same in structure as the last, but which form their shells of Silex (flint) instead of Calx (lime), are called **Polycystina.** These have not the same tendency to form composite structures, but are even more wonderful and more minute than the others. It is quite impossible to describe the marvellous variety or beauty of form of these shells. I have before me, under the microscope at this moment, a slide with a circular cell, containing what appears to be about as much very fine sand as could lie on the point of your penknife. This comes from the rock in the island of Barbadoes, and when examined by means of the light *thrown upon* the cell by the condenser, turns out to consist of innumerable shells, and of such infinite variety that the slightest movement of the slide shows an entirely new set; and each one of these is perfect in

* Ehrenberg, Johann Gottfried, a distinguished German naturalist, born in 1795. He was famed for his microscopic observations in animal life.

form. Some are like bells, others like globes, some like stars, others resembling globes with spikes projecting. All of these seem to be carved with the utmost care out of ivory, something like the far-famed carved Chinese balls, yet all so infinitely small that an immense number of them only form a few grains of sand so fine as to be almost impalpable. No organs by which this secretion of silex forming these wonderfully beautiful shells exist; the minute animal consisting simply, as already stated, of a speck of gelatinous matter, which it is impossible to reduce to further simplicity. "We scarcely condescend," observes Lamarck, a celebrated French naturalist,* "to examine microscopic shells, from their insignificant size; but we cease to think them insignificant when we reflect that it is by means of the smallest objects that Nature everywhere produces her most remarkable and astonishing phenomena. Whatever she may lose in point of volume, in the production of living bodies, is amply made up by the number of individuals which she multiplies, with admirable promptitude, to infinity. The remains of such minute animals have added much more to the mass of materials which compose the exterior crust of the globe, than the bones of elephants, hippopotami, and whales."

The last section of the Protozoa is that comprehending the **Porifera**† or **Sponges.**

The living sponge consists of an assemblage of amœba-like particles of gelatinous matter, which, however, instead of forming shells, deposit a network of a horny or calcareous character, and sometimes (especially those found on our coasts) crystals of flint.

The horny skeleton from which the film of animal matter has been removed, becomes the sponge we use;

* Born, 1744; died, 1829. † *Porus*, a passage; *fero*, I bear.

and it would seem certain that those species which have gathered into their structure siliceous particles, have, on the death of the animals, formed centres to which further crystals of flint have attached themselves; and that this has been the origin of the stone now known as **Flint**. The following passage, by Professor Rymer Jones, is given in support of this theory:—"Were we to inform our young readers that flints have been sponges, and that every flint wherewith in many parts of the country the roads are paved, and which, before the invention of lucifer matches, constituted almost the only means of obtaining fire, had grown at the bottom of the sea, rooted upon the rocks, and sucking in the surrounding water through innumerable pores upon their surface, which conveyed through every part of their soft texture materials for their subsistence, we could scarcely expect the assertion to be credited—at least, without considerable hesitation; and yet no fact in natural history is more easily demonstrated. Not only do the fragments of flints examined under the microscope reveal the fossilised texture of the sponge, but not unfrequently the shells of the animalcules upon which they lived are found in their substance; and even portions of the sponge itself, as yet unpetrified, are often contained in their interior."

Various species of sponge are used: two from the Levant, and another, of a very coarse kind, from Florida and the West Indies. The trade is carried on chiefly by the Turks and the inhabitants of the Bahama Islands. The boats used in the gathering of sponge on the coasts of Barbary, Candia, and Syria, furnish employment for about 5,000 men, the sponge being obtained either by diving or dredging. The value of the sponges collected in Greece and Turkey is from £90,000 to £100,000 annually. We import about 200,000 or 300,000 lbs. of Mediterranean sponge, at from seven to sixteen shillings

per pound; but when it reaches this country, it is mostly found to weigh much heavier than it really is, owing to the dealers having, before shipping it, soaked it and filled it with sand to increase its weight. It is therefore usual, in purchasing, to bargain to be allowed to beat the sponge for a certain time before weighing, in order to get rid of the sand. About 215,000 large, coarse sponges, worth about £17,000, are sent to Great Britain from the Bahamas and other West India islands. These are torn up from rocks by means of a fork at the end of a long pole; and in order to cleanse them from the gelatinous matter which surrounds them, they are buried in sand and afterwards soaked in water.

The limits of this manual compel me here to close. I have endeavoured to trace the works of the Creator as exhibited in the animal life in various forms. I need not say that all that has been written here forms the merest outline, the most bald index, to the glorious works of the Creator. I would therefore urge the reader to follow up the study by consulting more extensive and elaborate works, and, above all, by original investigation and examination. And in thus pursuing this subject, I venture to hope that the systematic arrangement of this little book will prove of real service to him.

QUESTIONS FOR EXAMINATION,

BASED ON THE FOREGOING TEXT.

1. Explain the meaning of each of the following terms:—Species, Genus, Order, Class.

2. Classify the animal creation according to Cuvier, and state which class has since been further added to and divided.

3. Name and sketch examples of each of the great divisions of the Animal Kingdom.

4. Give the names of the classes into which Vertebrate animals are divided, and the leading characteristics of each. Sketch one animal in each group.

5. What is meant by the *higher* and *lower* animals?

6. What animals constitute the order Monotremata? Sketch them, and give some account of their natural history.

7. Name the orders into which Mammalia are divided, and sketch an example of each.

8. What are the characteristics of Marsupials, and from what word is their name derived? Name the animal representing them, and give some account of its habits.

9. To which group do Opossums belong, and in what countries are they found?

10. Although the Flying Opossum in some respects resembles the Flying Squirrel, how would you discover the difference if a skull of each were shown you?

11. What group of animals constitute the class called Cetacea?

12. How can you prove that it is wrong to call a Whale a *fish?*

13. Name different families into which Whales are divided.

14. Give some account of the Whalebone Whale. Name the trade products we obtain from it, stating the purposes which each of these serves to the animal.

15. From what animal is Spermaceti obtained? Where is it situated in the animal, and what are its medicinal qualities?

16. Sketch and compare the heads of the Whalebone-Whale, the Dolphin, and the Porpoise.

17. What is meant by Ungulated and Unguiculated Mammalia?

18. How are the Ungulated Mammalia divided? Name an example of each group.

19. Give, in brief, the natural history of the Elephant, and name the trade product we obtain from that animal.

20. What is meant by the term Pachydermata, and what families are comprehended by it?

21. Give some account of the Hippopotamus, the Hog, and the Tapir.

22. Give briefly the natural history of the Rhinoceros, and explain the difference between its horn and that of the Narwhal.

23. To what group of animals does the Horse belong? What other animals belong to the same family?

24. What is remarkable in the dentition of the Horse?

25. What are the leading characteristics of Ruminants?

26. Give a sketch of the stomach of a Ruminant, and describe the process of rumination.

27. Describe the Camel, the Llama, and the Musk.

28. How are the horns of Ruminants classified? Describe the formation of each.

29. What useful products do we obtain from Ruminants?

30. What is meant by Edentata? In what particular respect do all the animals of this order agree?

31. Give an account of the structure and mode of life of the Sloth.

32. Sketch and describe the habits of the Armadillo.

33. Which animal best represents the order Edentata? Sketch and describe it.

34. Describe the dentition of Rodents, and sketch a skull of one of them.

35. Which families of the Rodents possess collar-bones, and which are without them

36. Give some account of the leading characteristics of the Beaver, the Hamster, the Marmot, and the Porcupine.

37. What is the nature of Carnivora?

38. Describe their dentition.

39. Into what groups are Carnivora divided?

40. To which of these do Bears belong? Give some account of their mode of life.

41. Which animals constitute the group called Digitigrade Carnivora?

42. Describe the claws of the Feline race.

43. Give some account of Dogs, taken from your own knowledge of them.

44. Describe the Wolf, the Jackal, and the Fox.

45. Describe the animals known as *Vermiform* Carnivora.

46. State the group to which the Seal and Walrus belong, and give a brief description of their forms and habits.

47. To which order of Mammalia do the Mole, Hedgehog, and Shrew belong? Describe their modes of life.

48. What name is given to the order represented by the Bat? Describe the flying apparatus of these animals, and the habits of the group generally.

49. What animals are comprised in the group Quadrumana? Is the name well applied? Give the reason for your reply.

50. Name the groups into which Quadrumana are divided, and state the characteristics of each.

51. What are the distinguishing characteristics of Bimana?

52. Give a full account of the structure of Birds.

53. Name the orders into which Birds are divided. Give the leading characteristics, and name an example of each.

54. Describe the feet and beaks of Raptores.

55. Which birds are comprehended by the term Diurnal, and which by Nocturnal, Raptores?

56. Describe the Eagle, the Hawk, and the Vulture.

57. In what respects do Owls differ from other birds in their habits, plumage, and in the arrangement of their eyes?

58. What is meant by Passerine birds? Draw the beak and foot of one of them, and give an account of some of the birds belonging to the group, taken from your own knowledge.

59. In what does the peculiarity of the order called Scansores consist? Draw the head and foot of one of them.

60. Describe the Woodpecker.

61. Name some of the birds belonging to the order Rasores. State why they are so called, and what purpose is served by the habit from which these birds derive their name?

62. To which order of birds does the Ostrich belong? Give some account of this bird, and of others belonging to the group.

63. What is the peculiarity of the birds constituting the class called Grallatores? Name some of them.

64. Give some account of the Stork, the Adjutant, the Ibis, and the Flamingo.

65. What are the habits of the birds known as Nata-

tores? Name some of them, including those in which the power of flying is the most developed, and those in which it is the most limited.

66. What are Reptiles, and how are they classed?

67. Describe the construction of the covering of Tortoises and Turtles, and give some account of each.

68. Give the natural history of Saurians.

69. Describe the animals representing the different families of Ophidians. Explain the construction of their spinal column.

70. Sketch and describe (1) the poison-fangs of venomous serpents, (2) the construction of their jaws.

71. What is the precise meaning of *amphibious?* Describe a truly amphibious animal.

72. Sketch and describe the transformation which takes place in Batrachians.

73. What is peculiar to the construction of Fishes?

74. How do fishes breathe, and why is their blood cold?

75. Sketch the skeleton of a fish, and show the position of the various fins.

76. How are fishes classified (1) according to their skeletons, and (2) according to their fins?

77. Name some of the fishes comprehended in each of these groups.

78. Describe the Sturgeon, and name the trade products obtained from it.

79. How does the Lamprey differ from the Eel?

80. What are the characteristics of the Articulata?

81. Describe (1) the Annelida, (2) the Myriapoda.

82. What is meant by the term Insects? Describe the transformations of a Silkworm.

83. Describe the Arachnida, and show how they differ from Insects.

84. What animals are comprised in the group Crustacea, and what are their leading characteristics?

85. Describe the Rotifera.

86. What are the distinguishing features of the Mollusca? Name the leading groups of them.

87. How do the shells of the Conchifera differ from those of the Gasteropoda?

88. What is understood by the term Radiata?

89. Describe the Echinus.

90. What are the Acalephæ?

91. What is meant by the Polypifera?

92. Describe and sketch the Fresh-water Hydra.

93. Give an account of the formation of Madrepores.

94. How does this formation differ from that of Corals?

95. To what group of animals do Corals belong? Whence and how are they obtained?

96. What are the Tubipora?

97. What is meant by Protozoa?

98. What are the Rhizopoda?

99. What is the difference between Foramenifera and Polycystina?

100. Describe the formation of sponges.

QUESTIONS

Selected from those which have been given in the Examination Papers of the Government Department of Science and Art; the Oxford Middle Class Examinations; the Preliminary Examinations of the College of Surgeons; the College of Preceptors, &c.

1. To what sub-kingdom, class, and order does the Snail belong? State anything you know about its structure and habits.

2. How many orders of birds are there, and how are they distinguished from one another?

3. What is the tortoiseshell? What are the most remarkable peculiarities of the animals which produce it?

4. What are the chief divisions of the Animal Kingdom?

5. What animals are called Annulose, and why?

6. What is the most striking peculiarity of the order of Mammals to which the Kangaroo belongs?

7. What common Mammals are devoid of teeth in the fore part of the upper jaw?

8. In popular language both the Whale and Salmon are called fishes. Why do naturalists place them in distinct classes, and what are those classes?

9. What sort of animals fabricate univalve and bivalve shells? State anything you know respecting their structure.

10. Name six examples of Molluscous animals.

11. What are the orders of Reptilia, and how are they distinguished from one another?

12. Describe the structure and habits of the fresh-water Polype, or Hydra.

13. Give some examples of animals which undergo metamorphosis.

14. To what sub-kingdom, class, and order do Sloths belong? Where are they found, and what are their habits?

15. What is Ivory, and whence is it obtained?

16. What are the breathing organs of fishes, and how do they breathe?

17. What are the chief distinctive characters of the Ruminantia?

18. How do the teeth of a cat differ from those of a sheep, and what relation can be pointed out between the forms and kinds of the teeth, and the habits of life of each?

19. What animals are called "Zoophytes," and why?

20. Give examples of migratory animals, and state the reason for their migration?

21. What are the mammary glands, and what animals possess them?

22. Enumerate the orders of birds, and give the characteristics of the order Raptores?

23. Describe the transformations of a frog, or of a newt, in respect to the organs of locomotion and of respiration.

24. How does the Viper differ from the harmless common snake?

25. What is meant by hybernation, and what animals hybernate?

26. What fishes possess the power of giving electric shocks?

27. What are Star-fishes? Give an account of their structure. State to what sub-kingdom, class, and order they belong.

28. Have any vertebrated animals more, and have any fewer, than two pairs of limbs?

29. What is the so-called Cuttle-bone? Give an account of the animal which produces it.

30. What differences are observable in the structure of the teeth and stomach in vegetable-feeding animals, as compared with those which live on flesh?

31. Describe what is peculiar in the stomach of a Ruminant.

32. To what class and order does the Sturgeon belong? Give an account of the natural history of that fish.

33. Give the natural history of the common Crab.

34. What animals are contained in the division Mollusca?

35. Give an account of the natural history of the Herring.

36. Where is the red Coral of commerce obtained, and by what animal is it formed?

37. Give an account of the natural history of the Sea Urchin.

38. Arrange under their proper order, class, and sub-kingdom the following animals :—The Dog, Cow, Whale, Kangaroo, Cod, Oyster, Lobster, Snail, Star-fish, and Sea Anemone; and give, if you can, the scientific names of these examples.

39. To what sub-kingdom and class do Barnacles and Acorn-shells belong, and why?

40. To what classes, orders, and families do the following animals belong :—The Horse, Lion, Seal, Porpoise, Rat, Weasel, Ostrich, Sparrow?

41. Why are certain animals called vertebrated? What are the classes of the Vertebrata, and how are they distinguished from one another?

42. To what class and order do lobsters belong? What is peculiar in the construction of their eyes?

43. To what sub-kingdom, class, and order do the Seal and the Porpoise respectively belong; and what are the most striking differences presented by these animals?

44. How are Fishes distinguished amongst vertebrate animals?

45. What characters distinguish birds from Mammals on the one hand, and Reptiles on the other?

46. What are the chief differences between the Apes of the old world and those of the new world?

47. What are the characters of the order Rodentia? Give examples of that order.

48. What are the Infusoria? Give an account of the structure and habits of any member of this group.

49. To what sub-kingdom, class, and order do Elephants belong? How many species of Elephants are there, and where are they found?

50. What are the most striking peculiarities of Plantigrade animals?

DICTIONARY OF TERMS, AND INDEX.

D

E

F

G

H

I

J

K

L

M

Q

R

S

T

U

V

W

Z

CASSELL, PETTER, AND GALPIN, BELLE SAUVAGE WORKS, LONDON, E.C.

SELECTIONS FROM

Cassell, Petter, & Galpin's

WATER COLOURS.

In Mahogany, with Sliding Top.

No.		s.	d.
1.	Improved Colours, 12 Cakes, Brush, and Saucers	0	4
2.	Superfine Colours, 18 Cakes, Brush and Saucers	0	6
6.	The Boy's Box of Colours, 12 Cakes, d..., do....	0	6
7.	The Shilling Colour Box, 14 Cakes, do., do.	1	0
8.	The Unique Colour Box, 18 Cakes, do., do.	1	9
9.	The Educator Colour Box, 27 Cakes, do., do....	3	0
	THE FINE ART COLOUR BOX, No. 1, containing 12 whole Cakes of the finest Colours, Brushes, Pencils, Slab, Compasses, Indian Ink, &c., in a handsome Mahogany Case, lock and key	10	6
	THE FINE ART COLOUR BOX, No. 2, containing 8 whole Cakes of the finest Colours, Brushes, Slab, Indian Ink, in a handsome Mahogany Case, with lock and key	7	6
	THE TECHNICAL DRAWING BOX, containing Set of Mathematical Instruments, Colours and Slab, Indian Ink, Pencil, India Rubber, Drawing Pins, Brushes, Set Square, 12-inch Rule, in Polished Wood Box, with sliding lid	5	0

COLOURS FREE FROM POISON.

In Mahogany, with Sliding Top, Polished Boxes.

120.	Containing 9 large Cakes, Brush, Crayons, and Saucers ...	1	0
121.	LA BELLE SAUVAGE COLOUR BOX, in Tin Case, with Lid to serve as Palettes, containing 12 Colours and Brushes ...	1	6
115.	Containing 15 small Cakes, Brushes, Crayons, and Saucers...	1	4
117.	Containing 15 large Cakes, Brushes, do., do.	2	3
119.	Containing 9 large Cakes, Compass, Stumps, Crayons, &c....	2	6
43.	Containing 18 large Cakes, Brushes, Crayons, and Saucers...	4	0
53.	Containing 15 large Cakes, Brushes, Crayons, Saucers, Square, Glue, &c.	5	0
55.	Containing 15 middle Cakes, Brushes, Crayons, &c., lock and key	5	6
54.	Containing 18 large Cakes, Brushes, Crayons, &c., lock and key	7	6
57.	Containing 12 large Cakes, in a handsome Case, inlaid with brass, Brushes, Glue, Gold, Silver, and Bronze Saucers, Rules, &c., Saucers, lock and key	9	6

JAPANNED TIN SKETCH BOXES,

WITH LIDS AND FLAPS TO SERVE AS PALETTES.

		s.	d.
Containing 12 Sixpenny Colours, Brushes, &c., complete ...	...	10	0
,, 16 ,, ,, ,, ,, ...	...	12	6
,, 20 ,, ,, ,, ,, ...	...	15	0

Japanned Tin Sketch Boxes, fitted with Extra Colours to Order.

N.B.—Any of the above Water Colours may be had by order through any Agent, care being taken to secure those supplied by Messrs. CASSELL, PETTER & GALPIN. Should any difficulty arise as to the supply of any articl ordered, the Publishers will be happy to send it direct, on receipt of the amount i stamps, or per Post-Office Order.

CASSELL, PETTER, & GALPIN, LONDON, PARIS, AND NEW YORK

SELECTIONS FROM

Cassell, Petter, & Galpin's

MATHEMATICAL INSTRUMENTS.

No.		s.	d.
50.	Deal Wood Box, varnished, containing Compass, Pen and Pencil, Crayon	1	0
51.	Deal Wood Box, varnished, containing 4½-in. Compass, Pen and Pencil, Rule, and Crayon Holder	1	6
52.	Deal Wood Box, with addition of Ruling Pen and Horn Protractor	2	0
53.	Same, ditto, painted, Compass, Pen and Pencil, Ruling Pen, Lengthening Bar, Horn Protractor, Rule, and Crayon Holder	2	6
54.	Same, ditto, with two Compasses	3	0
55.	Same, ditto (5½-in. Instruments)	3	6
56.	Rosewood Case, with two Compasses, Pen and Pencil, Lengthening Bar, Ivory Ruling Pen, Horn Protractor, Rule, and Crayon Holder	6	0
57.	Rosewood Case, with lock and key, two Compasses, Bow Pen and Pencil, Bar, Ivory Ruling Pen, Protractor, Parallel, Scale	7	6
58.	Rosewood Case, with lock and key (superior instruments), three Compasses, Bow Pen and Pencil, Bar, Ivory Ruling Pen, two Protractors, Parallel, Scale	10	0
59.	Handsome Rosewood Case, inlaid with brass, lock and key, Proportional Compass, three Compasses, Bow Compasses, two Ivory Ruling Pens, Bar, two Protractors, Parallel, Scale, Curve, Set Squares	25	0
60.	Rosewood Case, inlaid, lock and key, Proportional Compass, three Compasses, Bow Pen and Pencil, two Ruling Pens (Ivory handles), Bar, two Protractors, Parallel, Scale, Curve, Set Squares	23	0
61.	Richly Inlaid Rosewood Case, with lock and key, highly-finished Instruments, Proportional Compass, three Compasses, three Bow ditto, two Ruling Pens (Ivory handles), Bar, two Protractors, Parallel, Scale, Curve, and Set Squares	35	0
63.	Rosewood Case, richly inlaid, containing three Compasses, Bow Compass, Pen and Pencil, Ivory Ruling Pen, Bar, Protractor, Parallel, Scale	15	0
68.	Rosewood Case, lock and key, containing highly-finished Instruments in German Silver, three Compasses, Bow ditto, with Pen and Pencil, Ivory Ruling Pen, Bar, Protractor, Parallel, Scale	21	0

N.B.—Any of the above Mathematical Instruments may be had by order through any Agent, care being taken to secure those supplied by Messrs. CASSELL, PETTER, & GALPIN. Should any difficulty arise as to the supply of any article ordered, the Publishers will be happy to send it direct, on receipt of the amount in stamps, or per Post-Office Order.

CASSELL, PETTER, & GALPIN, LONDON, PARIS, AND NEW YORK.

Cassell, Petter, & Galpin's

MICROSCOPES,

FOR SCHOOL USE AND PRIVATE STUDY.

	s.	*d.*
THE SOCIETY OF ARTS PRIZE SCHOOL MICROSCOPE, with Rack-and-Pinion Adjustment, three Magnifiers, which, being used separately and combined, give seven different Powers, Condenser, Animalcule Cage, Concave Mirror, &c., in polished Mahogany Case	10	6
Ditto, with Body and Eye-piece, converting it into a Compound Microscope	13	0
IMPROVED SCHOOL MICROSCOPE, with Superior Achromatic Combination, magnifying 20 and 90 diameters, in neat Mahogany Cabinet, with Brass Forceps, and two Glass Slips	21	0
COMPOUND ACHROMATIC MICROSCOPE, on Brass Foot and Uprights, Rack-and-Pinion Adjustment, two Achromatic Powers, Huyghenian Eye-pieces, Axis for Inclination, Stage, Pliers, Tweezers, &c., in Polished Cabinet	38	0
THE EDUCATIONAL MICROSCOPE, Rack Adjustment, mounted on elegant Tripod Stand, with corrected Huyghenian Eye-piece and a Superior English Achromatic Combination, giving a magnifying power of about 30,000 times superficial, in polished Mahogany Cabinet	42	0
COMPOUND ACHROMATIC MICROSCOPE, on Bronze Stand, very powerful, axial inclination, Huyghenian Eye-piece, Condenser on Separate Stand, three Achromatic Powers...	45	0
Ditto, ditto, larger. Concave Mirror, &c.	50	0
THE STUDENT'S MODEL MICROSCOPE, recommended by the Society of Arts, on Bronze Stand, to incline at any angle, with Rackwork Adjustment, Stage, two Huyghenian Eye-pieces, Condensing Lens on sliding upright Stand, Plane and Concave Mirrors, Revolving Diaphragm, and two superior Achromatic Object-glasses, in a superior polished Mahogany Cabinet, with lock and key	63	0

CASSELL, PETTER, & GALPIN, LONDON, PARIS, AND NEW YORK.

SCHOOL MATERIALS

SUPPLIED BY

CASSELL, PETTER, & GALPIN.

	s.	d.
WHITE CHALKS, in a box, containing one gross	2	0
COLOURED CRAYONS, 12 boxes, each containing 1 doz. in case, assorted colours...	3	0
Ditto, ditto, larger size	6	0
Ditto, ditto, largest size	12	0
INK ERASERS, ½ a gross in a box...	6	0
INDIAN INK, in sticks, from ... ... per doz.	1	0
HAIR PENCILS, from... ... ... per gross	3	6
PALETTES, according to size, from	0	6
DRAWING PENCILS (fine lead), HB, B, BB, H, and HH, each	0	4
DRAWING BOOKS, interleaved with Tissue Paper—		
No. 1. 7½ × 5½	0	6
2. 11½ × 7½	0	9
3. 11 × 10½	1	4
4. 15 × 11	1	9
CASSELL'S TECHNICAL PENCILS, adapted for use with Cassell's Technical Manuals and Penny and Sixpenny Drawing Copies, in six different degrees, viz., HB, B, BB, H, HH, and F ... ... per doz.	1	0
CASSELL'S TWO-COLOUR PENCILS, Red and Blue, Blue and Black, or Blue and Red ... ... per doz.	1	0

N.B.—Any of the above Materials may be had from any Agent, care being taken to secure those supplied by Messrs. CASSELL, PETTER, & GALPIN. Should any difficulty arise as to the supply of any article ordered, the Publishers will be happy to send it direct, on receipt of the amount in Stamps, or per Post-Office Order.

☞ CASSELL, PETTER, & GALPIN'S COMPLETE CATALOGUE of MATHEMATICAL AND OPTICAL INSTRUMENTS, COLOURS, SCHOOL MATÈRIEL, &c., gratis, on application.

CASSELL, PETTER, & GALPIN, LONDON, PARIS, AND NEW YORK.